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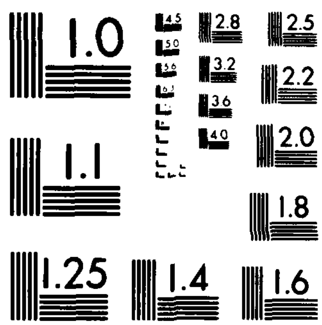

MICROCOPY RESOLUTION TEST CHART

EAST ST. LOUIS & VICINITY, ILLINOIS

CAHOKIA CANAL DRAINAGE AREA

MADISON and ST. CLAIR COUNTIES, ILLINOIS

ENVIRONMENTAL INVENTORY REPORT

Volume 2 of 6

Prepared by: Environmental Researchers of Edwardsville, Inc.

Prepared for: U.S. Army Engineer District, St. Louis - Corps of Engineers

St. Louis, Missouri 1981

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This six volume set represents a thorough environmental inventory of the Cahokia Canal/Harding Ditch Drainage Area in Madison and St. Clair Counties of Illinois. It was prepared as background information for a St. Louis District Army Corps of Engineers multi-purpose planning study.

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ENVIRONMENTAL INVENTORY REPORT

VOLUMES 1 AND 2

PHYSICAL ELEMENTS

VOLUME 1 - HYDROLOGICAL ELEMENTS

I GENERAL (INCLUDING FLOOD PROBLEMS) - [illegible]

II WATER AND SEDIMENT QUALITY - [illegible]

VOLUME 2 - ADVERSE ENVIRONMENTAL FACTORS

III AIR POLLUTION - [illegible]

IV NOISE POLLUTION - [illegible]

VOLUME 3

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BIOLOGICAL COMMUNITIES

AQUATIC COMMUNITIES

VI MACROPHYTES AND PHYTOPLANKTON - [illegible]

VII ZOOPLANKTON AND BENTHOS - [illegible]

VIII FISH - [illegible]

TERRESTRIAL COMMUNITIES

[illegible]

THE GEOGRAPHICAL LOCATION OF THE CAHOKIA CANAL AREA WITH RESPECT TO MAJOR AIR POLLUTION SOURCES

The Cahokia Canal Area is situated to the east and northeast of the St. Louis central business district at distances of one mile to twenty miles as seen in Figure III-1.* Most of the major industrial or point sources in the metropolitan area of St. Louis are not located within the Cahokia Canal Area but are located at moderate to long distances from the area, especially from the eastern sections of Cahokia Canal.

The largest point source located within the Cahokia Canal Area is the Granite City complex. The steel manufacturing complex has twenty-six stacks emitting varying amounts of particulate matter, sulphur dioxide, nitrogen oxides, hydrocarbons, and carbon monoxide. Other major point sources that clearly affect air quality levels throughout Cahokia Canal are displayed in Table III-1. These point sources are not physically within the study area, but are located within one to six kilometers of some part of Cahokia Canal.

A listing of major point sources within the Cahokia Canal area is presented in Table III-2. These point sources emit at the very least, twenty tons per year of one or more of the five pollutants mentioned above. A comparison of Figure III-1 and the listing in Table III-2 reveals that the northern and eastern sections of the study area are void of major point sources. These areas are typically rural in character and are affected (in terms of air quality) by

*All figures referred to are located in Volume 6 of 6 of this Environmental Inventory Report.

Table III-1

Proximate Major Point Sources to the Cahokia Canal Area*

Major Point Source	Location	Distance
1) Continental Grain	East St. Louis, Illinois	2.5 kilometers
2) Monsanto	Sauget, Illinois	5.0 kilometers
3) Illinois Power	Wood River, Illinois	6.0 kilometers
4) Amoco Refinery	East Alton, Illinois	4.0 kilometers
5) Clark Refinery	Hartford, Illinois	1.2 kilometers
6) Shell Refinery	Roxana, Illinois	1.1 kilometers
7) Malinckrodt Chemicals	St. Louis, Missouri	1.4 kilometers
8) PV International	St. Louis, Missouri	1.1 kilometers
9) Missouri Portland	St. Louis, Missouri	3.8 kilometers
10) Midwest Rubber Reclaiming Co.	Sauget, Illinois	5.5 kilometers
11) Amox Fine	Sauget, Illinois	5.0 kilometers
12) Sterling Steel Casting	Sauget, Illinois	5.1 kilometers
13) Edwin Cooper Company	Sauget, Illinois	5.0 kilometers
14) Pfizer Company	East St. Louis, Illinois	1.7 kilometers
15) Municipal North Incinerator	St. Louis, Missouri	2.8 kilometers
16) Union Electric (Ashley)	St. Louis, Missouri	1.2 kilometers
17) Purex	St. Louis, Missouri	4.3 kilometers
18) Monsanto	St. Louis, Missouri	4.9 kilometers
19) Anheuser Busch, Inc.	St. Louis, Missouri	6.0 kilometers
20) St. Louis Grain Elevator	St. Louis, Missouri	1.5 kilometers

*These sources are located at distances of 1.1 kilometers to six kilometers from the Cahokia Canal Area

Source: Illinois EPA, Point Source Emissions Inventory Section, Air Quality Analysis Division, June, 1978.

Table III-2

Major Point Sources within the Cahokia Canal Area

Point Source	Location
1) Granite City Steel	Granite City
2) U.S. Army Center	Granite City
3) American Steel	Granite City
4) Archer-Daniels Midland	Granite City
5) Reilly Tar and Chemical	Granite City
6) The Nestle Company	Granite City
7) LaClede Steel	Granite City
8) Union Electric	Venice
9) Swift Packing Company	National City
10) U.S. Agriculture and Chemical Co.	National City
11) St. Elizabeth Hospital	Granite City
12) Arnette-Pattern Company	Granite City
13) Allied Chemicals	Fairmont City

Source: Illinois EPA, Point Source Emissions Inventory Section, Air Quality Analysis Division, June, 1978.

low intensity area and mobile sources plus background levels from various sections of the St. Louis metropolitan area.

The heaviest concentration of large point sources is confined to the Tri-Cities area (Granite City, Venice and Madison). As will be pointed out in a later section of this report, this concentration is very evident in terms of simulated air quality levels in the vicinity of Granite City.

Area sources, like point sources, are concentrated in the southern and western sections of the Cahokia Canal Area. The obvious explanation for this is the concentration of urban land use in the southwestern part of Cahokia Canal and along the southern margin of the study area. The remainder of area sources, as they are distributed throughout the study area, consists of interstate, federal, state, and county highways.

FEDERAL AND ILLINOIS STANDARDS FOR THE MAJOR TYPES OF AIR POLLUTANTS

The standards adopted by the federal government (Environmental Protection Agency) as of November, 1971 are shown in Table III-3. The primary and secondary standards mentioned in the table are defined as follows in Section 109 of the National Environmental Protection Agency Act.

> National primary ambient air quality standards define levels of air quality which the Administrator judges are necessary to protect the public health with an adequate margin of safety. National secondary ambient air quality standards define levels of air quality which the Administrator judges necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

Table III-3

National Primary and Secondary Ambient Air Quality Standards

Pollutant	Type of Standard	Averaging Time	Frequency Parameter	Concentration µg/m³	ppm
Carbon monoxide	Primary and secondary	1 hr	Annual maximum[a]	40,000	35
			Annual maximum	10,000	9
Hydrocarbons (nonmethane)	Primary and secondary	3 hr (6 to 9 a.m.)	Annual maximum	160[b]	0.24[b]
Nitrogen dioxide	Primary and secondary	1 hr			
			Arithmetic mean	100	0.05
Photochemical oxidants	Primary and secondary	1 hr	Annual maximum	260	--
Particulate matter	Primary	24 hr	Annual maximum	260	--
		24 hr	Annual geometric mean	75	--
	Secondary	24 hr	Annual maximum	150	--
		24 hr	Annual geometric mean	60[c]	--
Sulfur dioxide	Primary	24 hr	Annual maximum	365	0.14
		1 hr	Arithmetic mean	80	0.03
	Secondary	3 hr	Annaul maximum	1,300	0.5
		24 hr	Annual maximum	260[d]	0.1[d]
		1 hr	Arithmetic mean	60	0.02

[a]Not to be exceeded more than once per year.
[b]As a guide in devising implementation plans for achieving oxidant standards.
[c]As a guide to be used in assessing implementation plans for achieving the annual maximum 24 hour standard.
[d]As a guide to be used in assessing implementation plans for achieving the annual arithmetic mean standard.

Source:
Larsen, Ralph I., Ph.D., "A Mathematical Model for Relating Air Quality Measurements to Air Quality Standards," U.S. EPA, Office of Air Programs, Research Triangle Park, N.C., November, 1971.

The Cahokia Canal Area is located almost completely within the southwestern part of Madison County, Illinois which has been under state monitoring and implementation plans for attaining the primary ambient air standards (with regard to particulates) since 1968. The recommended standards for gaseous pollutants which are presented in Table III-3 were not agreed upon for major urban-industrial locations in Illinois by the Illinois Pollution Control Board until April, 1972. A number of variances have been granted throughout Madison County to permit various point sources (industry) to alleviate air pollution control problems and still take steps to meet Illinois Environmental Protection Agency (IEPA) emission and air quality standards throughout the 1970s. The relatively recent passage of the 1977 Clean Air Act Amendments has made the attainment of the primary air quality standards (AQS) shown in Table III-3 mandatory by July, 1979. These primary AQS have not been attained in all or parts of Madison County and as a result some or all of the Cahokia Canal Area is classified by the EPA as a "nonattainment" area.

The extent of nonattainment areas in the St. Louis area is shown in Figure III-2. Part of Madison County is a classified nonattainment area and consequently a large portion of the Cahokia Canal Area is a nonattainment area, also. Five townships (Venice, Granite City, Nameoki, Collinsville, and Choteau) comprise all but the extreme northeastern part of the Cahokia Canal Area and as such, are a particulate nonattainment area which does not meet primary AQS on an annual basis.

The entire extent of the Cahokia Canal Area is designated as an ozone nonattainment area as seen in Figure III-2 in common with all of the seven county areas that constitute the standard metropolitan statistical area. Otherwise the Cahokia Canal Area is an area of attainment with respect to sulphur dioxide and carbon monoxide.

Table III-4 is included so as to provide a basis for comparison of the mathematically simulated isopleth values produced from the Illinois EPA short term model discussed later on. Unless pollutant values become inordinately high in a short period of time, the state EPA will not initiate an alert simply because ambient pollutant concentrations exceed the standards shown in Table III-4. As is indicated in Table III-4, a time factor is involved before levels of ambient air pollution that exceed federal AQS warrant the corrective steps EPA will take to reduce point source emissions.

One other variable besides high pollution levels and time should be taken into account when considering the hazards caused by air pollution. Within Metro-East, which includes all of the Cahokia Canal Area, the variable of scale or spatial dimensions will also affect the decisions as to whether high pollution levels justify the various stages of air pollution episodes shown in Table III-4. This situation is described and specifically covered by Rule 404 of IEPA regulations as follows:

> Certain of the SMSAs of the state, such as Chicago and East St. Louis, are very large. While most of the region may have acceptable air quality, one or more monitoring stations may report levels of contaminants high enough to call for episode control actions. In such a case, corridors of the (affected) region shall be defined, depending upon

Table III-4

Air Pollution Episode Levels

POLLUTANT	WATCH	YELLOW ALERT	RED ALERT	EMERGENCY
Suspended Particulate Matter (TSP)	2 hour 5 COH-625 μg/m^3	24 hour 3 COH-375 μg/m^3	24 hour 5 COH-625 μg/m^3	24 hour 7 COH-875 μg/m^3
Sulfur Dioxide (SO_2)	2 hour 0.30 ppm	4 hour 0.30 ppm	4 hour 0.35 ppm	4 hour 0.40 ppm
Product (SO_2 X TSP)	2 hour 1.0	4 hour 1.0 24 hour 0.20	4 hour 2.0 24 hour 0.80	4 hour 2.4 24 hour 1.20
Carbon Monoxide (CO)	2 hour 30 ppm	8 hour 15 ppm	8 hour 30 ppm	8 hour 40 ppm
Nitrogen Dioxide (NO_2)	2 hour 0.40 ppm	1 hour 0.60 ppm 24 hour 0.15 ppm	1 hour 1.20 ppm 24 hour 0.30 ppm	1 hour 1.60 ppm 24 hour 0.40 ppm
Photo-Chemical Oxidants (O_3)	2 hour (ADVISORY)	1 hour .17 ppm	1 hour .30 ppm	1 hour .50 ppm
Non-Methane Hydrocarbons (N-MHC)	none	none	none	none

Source: Illinois Environmental Protection Agency, 1975 Annual Air Quality Report, Division of Air Pollution Control, Ambient Air Monitoring Section, p. 6.

meteorological factors, emission inventory data, mathematical simulation modelling . . ., and alerts or emergencies shall be called for one or more individual corridors.

AIR POLLUTION CLIMATOLOGY OF THE CAHOKIA CANAL AREA

St. Louis and the adjacent environs are located rather well with respect to other sections of the United States whenever the frequency of air pollution episodes is considered. The isolines in Figure III-3 show that St. Louis is on the northwestern margin of an area centered in Georgia and South Carolina where a high frequency of air pollution episodes (on an annual basis) takes place. Air pollution episodes are relatively infrequent in St. Louis and material is presented in this section which focuses on indicators and factors which describe the atmosphere's capability to disperse and attenuate air pollutants to acceptable levels. Information is also presented to reveal any seasonal and diurnal variations of these factors as they occur in the St. Louis Area.

Two factors which affect the ability of the atmosphere to attenuate ground and low level emissions are wind velocity and the lapse rate. Variations in wind direction are significant also, because when averaged over a period of time, the pollution plume is spread out over a larger area. Steep or strong lapse rates and moderate to high wind velocities enhance the atmosphere's capacity to attenuate pollution levels. In the St. Louis area, relatively high wind speeds prevail on an annual and monthly basis as shown in Table III-5. St. Louis also experiences relatively strong lapse rates and higher mixing layer ceilings than in the southeastern United States and an indirect indicator of prevailing lapse rates is shown as mixing

Table III-5

Mixing Depth and Transport Wind Averages - St. Louis (1969-1972)

	MORNING						MIDDAY					
	Depth (in meters) of mixing layer			Transport Wind (meters/second)			Depth (in meters) of mixing layer			Transport Wind (meters/second)		
	# of obs.	$\bar{Y}$	σ_Y	# of obs.	$\bar{Y}$	σ_Y	# of obs.	$\bar{Y}$	σ_Y	# of obs.	$\bar{Y}$	σ_Y
Jan*	56	511	328	55	7.3	3.2	57	660	435	56	6.8	3.6
Feb*	55	513	337	48	7.6	3.1	53	712	395	49	7.1	4.0
Mar*	66	615	384	58	7.8	4.5	59	1167	742	56	7.4	3.7
Apr*	57	415	278	53	6.9	3.2	62	1321	791	59	7.2	3.5
May*	61	420	291	47	6.8	3.6	59	1650	782	58	6.7	3.3
Jun**	64	357	247	61	5.8	2.7	71	1779	762	52	5.6	2.5
Jul**	82	349	276	61	5.2	2.5	82	1824	774	73	5.0	2.7
Aug**	89	337	261	64	4.7	2.8	86	1576	754	86	4.4	2.1
Sep**	81	366	253	57	5.7	2.9	74	1461	823	70	5.0	2.9
Oct**	83	417	317	52	6.4	3.0	75	1189	766	70	6.4	2.9
Nov***	53	551	474	51	7.7	3.7	50	981	552	46	6.4	3.4
Dec***	55	542	269	50	5.8	2.6	55	762	491	50	5.9	3.5

* 1970-1972
** Values are for 1969-1972
*** 1969-1971

Source: Compiled and calculated from National Weather Service Radiosonde Data for St. Louis.

depth in Table III-5. The mixing depth (layer) defines the part of the atmosphere immediately above ground level up to the altitude of a temperature inversion. Inversions at altitudes of 1,000 to 10,000 feet are normally present over the St. Louis area all year as revealed in Table III-6, and act as a ceiling preventing further vertical dispersion at the top of the mixing layer. Normal lapse rates of varying steepness prevail within the mixing layer, while an isothermal or reverse lapse rate (a temperature inversion) above prevents vertical dispersion. A critical situation arises whenever a shallow mixing layer occurs with calm to light and variable wind conditions. If this combination persists for time periods of more than twenty-four hours in the Cahokia Canal Area, a high potential for an air pollution episode exists. This is particularly true for the bottomlands (the American Bottoms) of Cahokia Canal because it is a topographical basin which promotes the pooling or concentration of air pollutants emitted within the area as well as areas adjacent to Cahokia Canal.

The height (or depth) of the mixing layer by calendar month for the St. Louis area is displayed in Table III-5. The $\bar{Y}$ values in Table III-5 indicate the mean height (or depth) of the mixing layer for each month while the standard deviation per calendar month is symbolized by sigma sub Y (σY). A glance at Table III-5 reveals that nocturnal mixing layers are very shallow during the summer months, but during the daytime in the summer mixing layer heights attain a maximum. Transport wind velocity values, as revealed in Table III-5, are less in the summer months than during the transition seasons and the winter. Periods of calm (stagnation) are two to five times

Table III-6

Ventilation Values* and Lapse Rate Characteristics
(St. Louis Area - 1969-72)

Ventilation (1969-72)				Frequence of Occurence of High Altitude Inversions	
Month	# of Obs.	Mean Value (in meters)	Standard Deviation (in meters)	Present	Not Present
Jan	53	4,999	5,252	98.3%	1.7%
Feb	50	5,272	4,982	92.5%	7.5%
March	56	6,752	7,639	84.0%	16.0%
April	56	8,523	7,435	75.9%	24.1%
May	60	10,189	6,817	68.9%	31.1%
June	67	11,735	15,928	61.6%	38.4%
July	72	8,648	6,834	62.2%	37.8%
Aug	87	6,694	4,759	72.6%	27.4%
Sept	70	7,136	6,334	72.9%	27.1%
Oct	65	7,166	6,365	78.7%	21.3%
Nov	47	6,359	5,567	82.0%	18.0%
Dec	49	5,358	6,279	87.3%	12.7%

* Ventilation values are the product of mixing-layer depth and transport wind averages.

Source: Compiled and calculated by author from National Weather Service Radiosonde Data.

more frequent in the summer and early fall than in other months of the year, also. Consequently, if temperature inversion conditions develop close to the ground and persist throughout the day, the potential for low atmospheric attenuation capacity is much greater during the summer and early fall than during the winter, spring and late fall.

The most accurate guage or indicator of potential air stagnation (poor atmospheric attenuation capacity) to be developed is a measure known as midday mixing layer height and the transport wind speed. Values of less than 6,000 square meters per second and especially those less than 4,000 square meters per second appear to be conducive to high levels of air pollution in St. Louis when compared to past air pollution episode occurences. Figure III-4 shows that the frequency of ventilation values of less than 6,000 and 4,000 square meters per second, respectively, occur most often in July, August, and September. These are precisely the months in which air pollution episodes have occurred most frequently in the St. Louis Area since 1968. The mean ventilation values shown in Table III-6 indicate that the Cahokia Canal Area can expect the least amount of air pollution in April, May, June, and early July.

As pointed out earlier, the American Bottoms portion of the Cahokia Canal Area is situated in a topographical basin. With conditions of strong stability (weak to reverse lapse rate conditions), much of the pollution from surrounding area point sources is prevented from reaching ground levels in the area because of its lower elevation. The lower elevation of the Cahokia Canal Area may also facilitate accumulation of air pollutants whenever there are calm or light and variable wind conditions with a slight drift from the southeast, south, or southwest. There are indications that under these conditions a long, narrow vortex cell is set up in the American Bottoms with longitudinal axis extending north-northeast from Cahokia through East St. Louis, Madison, Granite City to Alton and Wood River.[1] This vortex appears to be produced by eastward flow (at elevations approximately the same as the bluffs which form the eastward boundary of the American Bottoms) and an average westward flow along the American Bottoms at ground level towards the longitudinal axis of the vortex. With stable atmospheric conditions (sunset to sunrise) and light southerly winds this circulation pattern would not disperse pollutants, but would simply recirculate and increase the level of air pollution in the American Bottoms portions of the Cahokia Canal Area.

The two models used in this report to mathematically simulate air pollution levels are the Illinois EPA Climatological Dispersion Model (CDM) and the Air Quality Short Term Model (AQSTM). Only the long term model (CDM) uses climatological data aggregated and arrayed on an annual basis. The Illinois EPA CDM calculates air pollution levels based on emission rates, stacks parameters, distance to receptors and atmospheric lapse and wind condition characteristics. Stability categories, as displayed in Table III-7, are utilized by the CDM to simulate the atmospheric ability to disperse pollutants horizontally and vertically depending on the prevailing lapse and wind conditions. Stability class 1 is an atmospheric condition which produces the most atmospheric dispersion per unit time, while class 6 causes the least

Table III-7

Occurence of Pasquill Stability Classes
in the Cahokia Canal Area

Stability Class	Frequency of Annual Occurence
1	1.46 percent
2	8.26 percent
3	11.82 percent
4	20.02 percent
5	17.25 percent
6	36.73 percent
Unclassified	4.46 percent

Source: Based on annual STAR data collected from Scott AFB, Illinois records and provided by the National Climatic Records Center, Asheville, North Carolina.

amount of atmospheric dispersion. Stability categories 2 through 5 represent various stages of transition between class 1 which simulates strong lapse rate conditions (atmospheric instability) and class 6 which simulates reverse lapse rate condition (atmospheric stability).

Tables III-8 and III-9 are included in this section to reveal ground level wind conditions on an annual basis in the Cahokia Canal Area. Wind speed classes are shown in Table III-8 which the CDM uses as part of its dispersion computations. Wind direction is displayed in Table III-9 for the Cahokia Canal Area, again on an annual basis. A quick perusal of Table III-9 reveals that southerly and northerly winds are much more frequent than easterly or westerly winds. This point should be kept in mind when viewing the patterns of air pollution simulated by CDM in the map section of this report.

POINT AND AREA SOURCE INVENTORY UTILIZED BY THE ILLINOIS CLIMATOLOGICAL DISPERSION MODEL (CDM) AND AIR QUALITY SHORT TERM MODEL (AQSTM) FOR THE CAHOKIA CANAL AREA

As mentioned in the last section, the Illinois CDM and AQSTM are utilized for air quality simulation in this report. Both models are sanctioned by the Federal EPA. For purposes of complete coverage, 275 point sources were included from all parts of the metropolitan St. Louis area plus the relatively distant Illinois Power generation plant at Baldwin, Illinois and Union Electric's Labadie power plant. All of the point sources used in both the CDM and the AQSTM emitted amounts of five tons per year or more for all of the pollutants modelled. The 275 point sources included in this emissions inventory accounted for 98.9 to 99.7 percent of all the emissions in the St.

Table III-8

Frequency of Occurrence of Wind Speed Classes in the Cahokia Canal Area

Wind Speed Class	Annual Frequency
1 (1-3 meters/second)	36.23 percent
2 (4-6 meters/second)	23.42 percent
3 (7-10 meters/second)	23.07 percent
4 (11-16 meters/second)	10.76 percent
5 (17-21 meters/second)	1.68 percent
6 (more than 21 meters/second)	0.38 percent
Calm	4.46 percent

Table III-9

Wind Direction Frequency on an Annual Basis in the Cahokia Canal Area

Wind Direction	Annual Frequency
North	8.62 percent
North-Northeast	4.77 percent
Northeast	3.82 percent
East-Northeast	3.15 percent
East	3.83 percent
East-Southeast	3.46 percent
Southeast	4.82 percent
South-Southeast	7.42 percent
South	15.73 percent
South-Southwest	6.46 percent
Southwest	5.49 percent
West-Southwest	3.57 percent
West	5.04 percent
West-Northwest	6.47 percent
Northwest	6.66 percent
North-Northwest	6.23 percent
Calm	4.46 percent

Source: based on annual STAR data collected from Scott AFB, Illinois and provided by the National Climatic Records Center, Asheville, North Carolina.

Louis metropolitan area, depending on the pollutant in question. The Missouri point source inventory was provided by the Missouri Department of Natural Resources and was the most recent data available (1978). The Illinois point emissions inventory was for 1977 and includes all point sources in Metro-East.

Tables III-10 to III-14 are included to show the largest point sources in the St. Louis metropolitan area for particulate matter (TSP), sulfur dioxide (SO_2), nitrogen oxides (NO_x), total hydrocarbons without methane (THC), and carbon monoxide (CO). Several of the point sources in Tables III-10 to III-14 are adjacent to or within the confines of the Cahokia Canal Area. These point sources were identified in Table III-1 and discussed at that time.

Because the western boundary of the Cahokia Canal Area is located next to downtown St. Louis (separated only by the Mississippi River) and the southern boundary includes only the northern fringes of St. Clair County, Illinois, Tables III-15 to III-17 are included for further clarification in regards to the location of large point sources relative to the Cahokia Canal Area. Four of the Madison County point sources listed in Table III-15 (Granite City Steel, Nesco Steel Barrel Co., Union Electric (Venice), and Reilly Tar and Chemical Co.) are located within the Cahokia Canal Area. Shell, Amoco, and Clark are located about four kilometers from the northern boundary, however, and Alton Boxboard and Illinois Power (East Alton) are located less than eight kilometers from the northern boundary.

St. Clair County point sources are listed in Table III-16. These sources are less than six kilometers from the southern boundary

Table III-10

Top Ten Point Emission Sources of TSP in the St.Louis Region*
(Tons/Year)

	Name	Amount	County & State	Municipality
1)	Golden Dip Co.	13,859	St. Clair, IL	Millstadt
2)	Missouri Portland Cement	8,416	St. Louis County (N)	Riverview
3)	Weber North	6,589	St. Louis County (W)	N/A
4)	Union Electric-Meramec	5,417	St. Louis County (S)	N/A
5)	Shell Refinery	3,631	Madison, IL	S. Roxana
6)	National Lead and Titantium	2,770	St. Louis County (S)	N/A
7)	Washington U. Power Plant	2,158	St. Louis	St. Louis
8)	Anheuser-Busch	1,984	St. Louis	St. Louis
9)	Bussen Quarry	1,809	St. Louis County (N)	N/A
10)	Illinois Power Co.	1,755	Madison, IL	East Alton

*does not include Union Electric's Labadie power plant nor the Illinois Power Baldwin power plant which are 14,054 and 8,328 tons per year, respectively

Source: Compiled by author from Illinois EPA Inventory Data (1977).

Table III-11

Top Ten Point Emission Sources of SO_2 in the St. Louis Region*
(Tons/Year)

	Name	Amount	County & State	Municipality
1)	Union Electric-Meramec	175,237	St. Louis County (S)	N/A
2)	Union Electric	112,598	St. Charles, MO	Portage Des Sioux
3)	Shell Refinery	37,863	Madison, IL	S. Roxana
4)	Anheuser-Busch	15,068	St. Louis	St. Louis
5)	Pfizer, Inc.	14,460	St. Clair, IL	E. St. Louis
6)	National Lead and Titantium	11,490	St. Louis County (S)	N/A
7)	Illinois Power Co.	8,937	Madison, IL	Wood River
8)	Union Electric-Ashley	7,783	St. Louis	St. Louis
9)	Monsanto	6,579	St. Clair, IL	Sauget
10)	Alton Mill & Paperboard Co.	3,737	Madison, IL	Alton

*does not include Union Electric's Labadie power plant nor the Illinois Power Baldwin power plant which are 340,257 and 358,348 tons per year, respectively

Source: Compiled by author from Illinois EPA Inventory Data (1977).

Table III-12

Top Ten Point Emission Sources of NO_x in the St. Louis Region*
(Tons/Year)

	Name	Amount	County & State	Municipality
1)	Union Electric-Meramec	28,309	St. Louis County (S)	N/A
2)	Shell Refinery	14,850	Madison, IL	S. Roxana
3)	Illinois Power	9,600	Madison, IL	East Alton
4)	Monsanto	6,579	St. Clair, IL	Sauget
5)	Anheuser-Busch	4,140	St. Louis	St. Louis
6)	Granite City Steel	2,280	Madison, IL	Granite City
7)	Missouri Portland Cement	2,240	St. Louis County (N)	Riverview
8)	Alton Paperboard Mill Co.	2,181	Madison, IL	Alton
9)	Union Electric	1,349	Madison, IL	Venice
10)	National Lead and Titantium	1.180	St. Louis County (S)	N/A

*does not include Union Electric's Labadie power plant nor Illinois Power's Baldwin power plant which are 30,010 and 132,458 tons/year, respectively

Source: Compiled by author from Illinois EPA Inventory Data (1977).

Table III-13

Top Ten Point Emission Sources of THC in the St. Louis Region
(Tons/Year)

	Name	Amount	County & State	Municipality
1)	Shell Refinery	8,502	Madison, IL	S. Roxana
2)	General Motors	7,191	St. Louis	St. Louis
3)	Chrysler Assembly Co.	6,252	St. Louis County (W)	Fenton
4)	Monsanto	5,951	St. Louis	St. Louis
5)	Reilly Tar & Chemical Co.	5,235	Madison, IL	Granite City
6)	Amoco Refinery Co.	4,734	Madison, IL	Wood River
7)	American Can Co.	3,867	St. Louis	St. Louis
8)	Monsanto	2,259	St. Clair	Sauget
9)	Phillips Pipe Line Co.	2,842	St. Clair	Sauget
10)	Clark Refinery Co.	1,428	Madison, IL	Hartford

Source: Combiled by author from Illinois EPA Inventory Data (1977).

Table III-14

Top Ten Point Emission Sources of CO in the St. Louis Region
(Tons/Year)

	Name	Amount	County & State	Municipality
1)	Granite City Steel	20,367	Madison, IL	Granite City
2)	LaClede Steel	5,931	Madison, IL	Alton
3)	St. Louis Municipal Incinerator	2,555	St. Louis	St. Louis
4)	St. Louis S. Municipal Incinerator	1,598	St. Louis	St. Louis
5)	Illinois Power	537	Madison, IL	Wood River
6)	Monsanto	139	St. Clair, IL	Sauget
7)	Phillips Pipe Line Co.	123	St. Clair, IL	Sauget
8)	Anheuser-Busch	120	St. Louis	St. Louis
9)	Allied Chemicals	102	St. Clair, IL	Sauget
10)	National Lead and Titantium	95	St. Louis County (S)	N/A

Source: Compiled by author from Illinois EPA Inventory Data (1977).

Table III-15

Ranked Point Sources in Madison County
Emitting More Than 1000 Tons Per Year

	Particulates (TSP)	Sulfur Dioxide (SO_2)	Nitrogen Oxide (NO_x)	Total Hydrocarbons (THC)	Carbon Monoxide (CO)
1)	Shell	Shell	Shell	Shell	Granite City Steel
2)	Ill. Power	Ill. Power	Ill. Power	Reilly Tar & Chemical	LaClede Steel
3)	Granite City Steel	Amoco	Granite City Steel	Amoco	
4)		Clark	Alton Mill Paperboard	Clark	
5)		Granite City Steel	Union Electric (Venice)	Nesco Steel Barrel	
6)			Amoco		

Source: Compiled by author from Illinois EPA Inventory Data (1977).

Table III-16

Ranked Point Sources in St. Clair County Emitting More Than 1000 Tons Per Year

	Particulates (TSP)	Sulfur Dioxide (SO_2)	Nitrogen Oxide (NO_x)	Total Hydrocarbons (THC)	Carbon Monoxide (CO)
1)	Golden Dip*	Pfizer, Inc.	Monsanto	Monsanto	---
2)	Continental Grain	Monsanto		Phillips Pipe Line (E. St. Louis)	---
3)	Pfizer, Inc.				
4)	Midwest Rubber Reclaiming				

*located in Millstadt, approximately 13 air miles from the southern boundary of the Cahokia Canal Area. This point source emits approximately 13 times as much particulate pollution as Granite City Steel does.

Source: Compiled by author from Illinois EPA Inventory Data (1977).

Table III-17

Ranked Point Sources in the City of St. Louis and Proximate Areas of Northern St. Louis County Emitting More Than 1000 Tons Per Year

	Particulates (TSP)	Sulfur Dioxide (SO_2)	Nitrogen Oxides (NO_x)	Total Hydrocarbons (THC)	Carbon Monoxide (CO)
1)	Mi. Portland Co.	Anheuser-Busch	Anheuser-Busch	General Motors	Municipal Incinerator (N)
2)	Washington University Power Plant	Union Electric (Ashley)	Union Electric (Ashley)	Monsanto	Municipal Incinerator (S)
3)	Anheuser-Busch	General Motors		American Car	Green Foundry
4)		Washington University Power Plant			
5)		Monsanto			

Source: Compiled by author from Illinois EPA Inventory Data (1977).

of the Cahokia Canal Area and include Continental Grain, Pfizer, Midwest Rubber Reclaiming Co., Monsanto, and Phillip's Pipeline. In St. Louis and proximate portions of northern St. Louis County, point sources within a six kilometer range of the Cahokia Canal Area boundaries include Missouri Portland, Anheuser Busch, Union Electric (Ashley), Monsanto, and Municipal North Incinerator. These are displayed in Table III-17.

Because of varying stack parameters involved and varying distances of the Cahokia Canal Area from these major point sources, not all of the sources listed in Tables III-10 through III-17 show up as major contributors to simulated levels of air pollution as predicted by the CDM or the AQSTM. The major point sources within the Cahokia Canal or those very close to the boundaries do show up invariably as the major contributors to air pollution levels in the Cahokia Canal Area as shown by the culpability routines in the CDM and AQSTM.

The Area Emissions Inventory is based on data provided by the Illinois EPA and Missouri Department of Natural Resources. Area emissions for St. Louis, Madison, and St. Clair counties are for 1977. Efforts were made to use area emissions data based on the Regional Air Pollution Study (RAPS) which was completed in 1976 in the St. Louis area. Because of technical problems involved with RAPS tapes, the data was not useable. An allocation procedure based on urbanization and industrial patterns in Metro-East and St. Louis was worked out similar to the procedure used by RAPS. As a result, the basic spatial unit used in this report's area emission inventory is one square kilometer. A grid consisting of 176 one square kilometer units was used in the urban areas and in the rural areas, sixteen two to five square kilometer units were applied. The grid for area emissions extends throughout the spatial extent of the Cahokia Canal Area, five kilometers westward into St. Louis and St. Louis County, four kilometers southward into East St. Louis, Sauget, Collinsville and Caseyville, and three kilometers northward.

LONG TERM MODELLING IN THE CAHOKIA CANAL AREA

Long term modelling of air pollution levels in the Cahokia Canal Area has been achieved by utilizing the Illinois Environmental Protection Agency (IEPA) Revised Climatological Dispersion Model.[2]

The Revised Climatological Dispersion Model (CDM) is used in simultaneously estimating long term concentrations of two non-reactive pollutants due to emissions from point and area sources.[3] The model assumes a Gaussian plume spread in both the horizontal and vertical planes. The Illinois Environmental Protection Agency (IEPA) Revised CDM contains several modifications.

One of the modifications which has been made to the original Climatological Dispersion Model consists of an option permitting simulation of a rural environment. CDM, as originally developed, was for use in an urban environment only. With the rural option, plume rise from point sources was completed utilizing subroutine BRIGGS, which incorporates the 1972 version of the Briggs' Plume Rise equations. Basically, computations differ from the original CDM in the manner by which plume rise during stable atmospheric conditions was handled. Compensation is made for this situation, however, because in the presence of stable conditions, the plume is not calculated to rise according to the two-thirds power to the distance of final plume rise as in the case of unstable or neutral conditions. The minimum rise of three calculated values is used for effective plume rise during stable conditions.

The rural option does not implement a modification of the stability classes as does the original CDM (urban option). Rather, the CDM stability classes (essentially, Pasquill-Gifford stability classes) are used without the alteration to account for a rural environment. The value of the initial sigma (σ) for point sources has been set to zero for the rural option. The urban option uses the original CDM initial value to represent the vertical dispersion created by the roughness of urban topography (buildings). The rural mixing height during stable conditions has no physical meaning since there is no mixing layer (i.e., stable conditions extend down to the ground). For this reason, during stable conditions in a rural area, the plume from any source will be emitted into the stable air.

The second most significant change is the addition of a culpability table for each pollutant in the printout. This table presents the contribution of each emission source at five selected receptors, or alternately, the five receptors with the maximum pollutant concentrations.

A third modification permits the model to accept a maximum of 350 point sources and 10,000 area sources, with the minimum grid square of the latter being one kilometer on a side. Calculations can be determined for a maximum of 200 receptors.

Although the revised CDM is designed to handle only non-reactive pollutants, an attempt has been made to model nitrogen dioxide (NO_x) and total hydrocarbons (THC) excluding methane. The model is designed, however, to adequately simulate sulfur dioxide (SO_2), particulates (TSP), and carbon monoxide (CO). The attempt to model THC and NO_x has been done by adjusting half-life times to one hour and two hours, respectively.

The mapping of the revised CDM output, that is, the simulated distribution of TSP, SO_2, NO_x, THC, and CO levels in the test area was accomplished by using SYMAP. SYMAP is a computer mapping program which allows one to exercise excellent mapping control and is fairly precise in terms of interpolation over geographic space.[4] Whenever there are steep gradients present, however, SYMAP tends to "stretch-out" higher levels of whatever phenomenon is being mapped than actually exists.

This characteristic of SYMAP is apparent in the case of Figure III-5 which displays the distribution of TSP as modelled by the revised CDM. Very steep gradients exist in the vicinity of Granite City Steel (approximately two kilometers west-northwest of Horseshoe Lake) and ambient TSP levels of more than fifty micrograms per cubic meter ($\mu g/m^3$) extend in all directions from Granite City farther than is the case when examining the CDM output. In the case of Figure III-5, as for all figures in this section where steep gradients occur, manual corrections have been made to take care of most of this type of error.

A comparison of ambient TSP levels in the Cahokia Canal Area as projected by the CDM with the primary air quality standard of seventy-five $\mu g/m^3$ shown in Table III-3, reveals that two areas appear to exceed that annual geometric mean value. The extreme southwestern corner of the test area in the vicinity of National City is above the seventy-five $\mu g/m^3$ standard as well as the aforementioned Granite City area. The remainder of the Cahokia Canal Area is well below the primary air quality standard of seventy-five $\mu g/m^3$. This is especially true in the area east of Horseshoe Lake where projected construction is scheduled.

A culpability analysis of the Cahokia Canal Area shows that in the southwestern corner, three point sources are the major contributors. Continental Grain, located in East St. Louis, Midwest Rubber Reclaiming Company in Sauget, and Golden Dip Company in Millstadt (thirteen miles distant) combine to contribute between sixty-six and seven tenths and eighty-one and eight tenths percent of TSP depending on the location in the southwestern portion of Cahokia Canal. In the Granite City area, Granite City Steel Company contributes more than eight percent of the TSP levels.

The long term distribution of SO_2 in Cahokia Canal is shown in Figure III-6. The distribution pattern is similar to that of TSP except that it is not as localized around the immediate Granite City area. It does exhibit highest concentrations in the Granite City vicinity, but does not exceed the primary annual arithmetic mean air quality standard of eighty $\mu g/m^3$. The distribution pattern shows a steep gradient from Granite City eastward and east of Horseshoe Lake, SO_2 ambient levels are well below the primary air quality standard. The prevalence of south and north winds on an annual basis is apparent when viewing the SO_2 distribution pattern in

Figure III-5. The large point sources that have a potential impact on the Cahokia Canal Area are situated in the western portion or are located south or north of the western portion of Cahokia Canal.

Four receptors, all of which are in the Granite City vicinity, when subjected to culpability analysis, reveal Granite City Steel to be responsible for thirty-two to forty-two percent of the SO_2 ambient levels. Shell, Monsanto (Sauget), Pfizer (East St. Louis), Union Electric at Meramec and Anheuser Busch account for an additional thirty-five and eight tenths to forty-seven and one tenth percent of SO_2 ambient levels. Union Electric power plants at Portage Des Sioux and Ashley, Nestle Company (Granite City), and Illinois Power at Baldwin (eighteen and seven tenths miles to the southeast) account for another seven and eight tenths to nine and seven tenths percent. In the southwestern part of Cahokia Canal, Shell refinery accounts for thirty-two percent and Pfizer Company (East St. Louis) accounts for twenty-one percent of ambient SO_2 levels. An additional twenty-eight percent is accounted for by Granite City Steel, Union Electric Power Plants (Portage Des Sioux, Labadie, and Meramec), Monsanto (Sauget), Missouri Portland, and Anheuser Busch.

Simulated long term ambient levels of THC are presented in Figure III-7. The pattern of simulated ambient long term levels of THC suggests, in general, a fairly steep east-west gradient in the test area as was the case for TSP and SO_2. Again this phenomenon reflects the prevalent annual south-north wind direction present in the Cahokia Canal Area and the sharp transition from urban-industrial land use in the western portion to sparsely populated rural land use in the eastern part. The Granite City area again is noticeable in terms of relatively high levels of ambient THC mainly because of Reilly Tar and Chemical Company which has several relatively low stacks at their facility. Other important contributors on an annual basis are the refineries, especially Shell, located to the north of the test area, and Monsanto (Sauget). It should be mentioned again at this point that any effort at modelling THC with a non-reactive model such as CDM is only an attempt to reveal broad patterns of spatial distribution and that the numbers or values assigned to the isolines in Figure III-7 are academic.

Long term ambient levels of NO_x are simulated in Figure III-8. The pattern of spatial distribution strongly resembles the THC patterns shown in Figure III-7. Once again, the Granite City area stands out as a relatively high location in terms of NO_x ambient levels. Two sources (Granite City Steel and Missouri Portland in northern St. Louis County) account for more than sixty-five percent of the ambient NO_x levels in Granite City and directly north. Shell refinery in South Roxana is also an important contributor especially in the south-central sections of the Cahokia Canal Area. The same caveat applies to the number values shown on the isolones of Figure III-8, as was stated for the numerical values displayed in Figure III-7. NO_x, like THC, are reactive gaseous pollutants and as such are not realistically treated by the CDM.

Carbon monoxide (CO) ambient levels are displayed in Figure III-9. The same general pattern is present for ambient CO levels as is the case for THC and NO_x. Again, the Granite City vicinity experiences higher levels of CO, because of the steel operations (principally Granite City Steel). Most CO in urban areas comes from mobile or area sources and this is also the case throughout the Cahokia Canal Area. Granite City Steel, however, is the number one point source of CO in the greater St. Louis area as displayed in Tables III-14 and III-15. Its contributions are substantial in the general neighborhood of Granite City. Some contributors to ambient CO levels near Granite City is also made by the municipal (North) incinerator located just across the Mississippi River. Because CO is relatively non-reactive, the numerical values for each of the isolines in Figure III-9 are considerably more valid than is the case for THC and NO_x. Because the scale of this map is too large to show the effects of motor vehicle emissions on the highways throughout the area, ambient CO levels due to motor vehicles are dealt with in a later portion of this section.

SHORT TERM MODELLING IN THE CAHOKIA CANAL AREA

Short term modelling (twenty-four hours or less) of air pollution levels in the Cahokia Canal Area was accomplished by using the IEPA's Air Quality Short Term Model (AQSTM) in the report.

The short term diffusion model is based on the Gaussian diffusion equation, which describes the diffusion of a plume as it is transported downwind from a continuously emitting source. The model computes ground level pollutant concentrations for specified averaging times ranging from one hour to twenty-four hours for non-reactive pollutants.

Through the application of appropriate atmospheric diffusion equations, the program determines ground-level concentrations of pollutants for specified time periods. The spatial distribution of two contaminants may be obtained in tabular form from the simulation. These tables allow the construction of isopleths which provide a complete regional picture of air quality in the vicinity of the source.

Output from the model includes a table of the source data, a receptor concentration table, and an option which provides a display indicating the contribution from each source to five selected receptors. Ground concentrations can be computed during simulation of early morning fumigation as well as during trapping conditions.

The effective stack height, which is calculated by the model, is the sum of the physical stack height and the plume rise. Plume rise is an incremental factor related to the buoyancy and vertical momentum of the affluent, which is calculated for each source according to the plume rise formulation presented by Briggs. Under stable atmospheric conditions, σ_z (the vertical diffusion) is restricted to a twenty-five meter vertical spread, while the plume is permitted to disperse normally in the horizontal. Simulated concentrations are not calculated by the model for A-stability conditions.

Measured concentrations downwind from a source decrease with sampling time mainly because of a larger σ_y, which is due to increased meander of the wind. Therefore, for time intervals greater than a few minutes, the AQSTM utilized Turner's recommended correction of $X_S = X_R(t_R/t_S)^{0.2}$, where X_S is the desired concentration for the sampling time t_x and X_R is the concentration determined using the diffusion equation for a sampling time of t_R (ten minutes).

The effects of each source in the region on each receptor are determined for input combinations of wind direction, wind speed, stability class, and mixing height. Concentrations are calculated for the specified time period during which the input meteorological conditions are assumed valid. The model sums the contribution from all sources and averages this concentration over the time period of interest.

Short term modelling of air pollution levels in this report is included because there are several meteorological conditions that occur frequently throughout the year and persist for several hours which might cause ground level concentrations to approach or exceed air quality standards. These adverse meteorological conditions consist of 1) trapping, 2) stagnation, 3) fumigation, and 4) high wind velocities under neutral conditions.[5]

In this report, conditions 1 and 2 are modelled via the AQSTM for all of the point and area sources in the St. Louis area. Fumigation (condition 3) is simulated only with the Granite City point sources plus Union Electric's power plant at Venice. Because the process of fumigation is so dependent on elevation of the point source and geographic variables, a more localized area within the Cahokia Canal area was selected. Granite City was the obvious choice, because of the heavy concentration of point sources located there and its proximity to possible areas of construction activity by the Corps to the east of Granite City. Condition 4 (high wind velocities under neutral conditions) or critical wind conditions, is not included because this condition is even more localized or sensitive to geographical variables and elevation of the point source than fumigation processes. The calculation of critical wind is appropriate only for individual stacks. An average meteorological condition (dispersion) is simulated by the AQSTM in this section, however, for the purpose of comparison with trapping and stagnation.

Simulated ambient levels of TSP and SO_2 over the Cahokia Canal Area under trapping conditions are shown in Figures III-10 and III-11. A wind direction of 270 degrees subjects the Cahokia Canal Area to St. Louis city point sources and point sources within the test area. A velocity of four and four tenths meters per second is assumed as well as a low altitude inversion base height of 583 meters. (This altitude is the effective stack height of Illinois Power's Wood River power generation plant which is the highest of all proximate major point sources under unstable atmospheric conditions or class B-stability). The values shown in Figures III-10 and III-11 are twenty-four hour averages. As can be seen from these figures, ambient levels of TSP and SO_2 are highest in the vicinity of Granite City, but do not approach the twenty-four hour air quality standards of 260 and 365 micrograms per cubic meter for TSP and SO_2, respectively.

Simulated ambient levels for TSP and SO_2 under the trapping conditions outlined above with a wind direction of 185 degrees are shown in Figures III-12 and III-13. A 185 degrees wind subjects the Cahokia Canal Area only to Illinois sources of pollution except for the point sources along the immediate waterfront area of the Missouri side of the Mississippi River. Again, only twenty-four hour values are depicted in Figures III-12 and III-13. The only appreciable concentrations of TSP and SO_2 in all of the Cahokia Canal area are in the Venice and Granite City vicinities. These concentrations are well below the twenty-four hour air quality standards for TSP and SO_2.

A wind direction of 330 degrees subjects the Cahokia Canal Area to mostly Illinois point sources also, especially the Wood River-Hartford refinery complex. In addition, parts of this area will be affected by the plume from the Union Electric's Portage Des Sioux power plant. Figure III-14 is included to show ambient twenty-four hour average TSP and SO_2 levels under trapping conditions with a 330 degree wind. The only concentration of appreciable TSP is in the area just to the south and east of Granite City Steel. Culpability analysis shows that these levels are mostly Granite City Steel and some contributions (eighteen percent) from Missouri Portland Cement. SO_2 ambient concentrations as depicted in Figure III-15 show two areas where substantial concentrations occur. The first area near National City (the extreme southwestern corner) exhibits the highest concentrations (267 $\mu g/m^3$ maximum) which culpability analysis shows to be the combined impact of Malinckrodt Chemical Company (Missouri), Union Electric at Venice and Ashley (Missouri). The second area near Granite City appears to be from the confluence of Missouri Portland Cement, Granite City, and American Steel whenever a north-northwest wind prevails. Neither the National or Granite City areas approach or exceed twenty-four hour air quality standards for TSP or SO_2 under these conditions.

Ambient twenty-four hour average levels of TSP and SO_2 under stagnation conditions are shown in Figures III-16 and III-17. Stagnation, as the term implies, consists of light and variable winds with a temperature inversion base level within a few hundred meters above ground level. In this report, a temperature inversion only 500 meters above ground level and a wind velocity of two meters per second was assumed. A wind direction of 225 degrees was assumed also, because a drift from that direction produces the highest background levels over the Cahokia Canal Area.

In Figure III-16, it can be seen that there are several small areas where ambient TSP concentrations exceed 100 $\mu g/m^3$. As in the case of atmospheric trapping, the National and Granite City areas are conspicuous. An area of relatively high TSP concentrations occurs four kilometers down wind from Granite City in mainly a rural area. This is the result of several plumes converging from elevated, but large, major point sources. Concentrations of ambient TSP, however, do not exceed the twenty-four hour TSP air quality standards.

The simulated twenty-four hour ambient levels of SO_2 under stagnation conditions shown in Figure III-17 reveal a more localized pattern of relatively high concentrations than is the case for TSP. Levels of ambient SO_2 exceeding 100 $\mu g/m^3$ are restricted to a small area west of National City. Elsewhere throughout the extent of the Cahokia Canal Area, concentrations are well below 100 $\mu g/m^3$. As is the case for ambient TSP levels, there is not any part of the Cahokia Canal Area where ambient levels approach or exceed the ambient twenty-four hour SO_2 air quality standards.

Patterns of TSP and SO_2 ambient levels are shown in Figures III-18 and III-19 under a meteorological condition known as fumigation. Fumigation occurs nearly every day in the early to mid morning hours. During the night, ground level temperature inversions form and persist until sunrise. When the ground begins to absorb radiation from the sun, the ground heats up and the temperature inversion begins to break up from the ground upward. This process may take from one hour to three hours to completely breakup the temperature inversion. During the breaking-up of the ground level temperature inversion, elevated ground level emissions can disperse downward, but not upward provided they are below the base of the temperature inversion. This phenomenon is known as fumigation and results in higher than normal concentrations until the temperature inversion disappears.

Because the IEPA AQSTM is very sensitive to effective stack height when modelling for fumigation conditions, only the Granite City point sources were modelled plus the Union Electric (Venice) power station. Granite City was chosen because it is the major concentration of point sources within the study area. A 270 degree wind was selected as this is the direction which will subject the area where Army Corps of Engineers work is projected to be, most quickly to Granite City point sources of emission. As can be seen in Figure III-18, ambient TSP levels are concentrated in the Granite City Steel complex vicinity. The highest ambient TSP level is 259 $\mu g/m^3$ and levels of more than fifty $\mu g/m^3$ extend downwind for a distance of about three and five-tenths miles. Ambient TSP levels under fumigation conditions approach and almost exceed the twenty-four hour air quality standard of 260 $\mu g/m^3$ in the immediate vicinity of Granite

City Steel. TSP levels, elsewhere in the Cahokia Canal Area are well below the twenty-four hour standard.

Ambient SO_2 concentration under conditions of fumigation are displayed in Figure III-19. Again, Granite City Steel impacts the area the most, but the effects are very localized as was the case for TSP concentrations shown in Figure III-18. The gradiant is very steep, with the maximum (simulated) amount of 269 $\mu g/m^3$ occurring within the Granite City Steel Company area. The SO_2 levels east of Horseshoe Lake are projected to be less than 50 $\mu g/m^3$ and as a result will impact the area of possible construction only to a slight degree.

The ambient twenty-four hour concentration of TSP and SO_2 under atmospheric dispersion conditions are revealed in Figures III-20 and III-21. Atmospheric conditions assumed for Figures III-20 and III-21 adopt a wind velocity of five meters per second and neutral stability conditions (class D-stability). Dispersion conditions over a year's time occur more frequently than trapping, fumigation, or stagnation and are characterized by higher wind velocities and greater conditions of homogeneity in terms of atmospheric stability throughout the lower two to five thousand feet of the atmosphere. For modelling purposes, frequently, there is no upper or lower inversion condition to consider as is the case for trapping, stagnation, and fumigation. This condition is the basis for initiating critical wind speed calculations so as to ascertain maximum concentrations of ambient pollutants downwind.

The patterns of ambient TSP concentrations shown in Figure III-20 help to imply what happens to pollutant plumes from elevated stacks to major point sources. The highest ambient levels of TSP occurs four to five miles downwind from the Granite City Steel complex near the intersection of Interstate 270 and State Highway 111 instead of immediately downwind as was the case for stagnation and trapping conditions. Other relatively high levels of ambient TSP occur in the southwestern area of the bottomlands of the Cahokia Canal Area. These ambient TSP levels are due mainly to emissions from Continental Grain and Pfizer, Inc. (in East St. Louis) and Missouri riverfront industries. In any case, ambient TSP levels are less than the twenty-four hour AQS throughout the Cahokia Canal.

SO_2 ambient concentrations under dispersion conditions are depicted in Figure III-21. Relatively high levels of ambient SO_2 are limited to the southwestern corner of the Cahokia Canal Area. Most of the concentrations of SO_2 shown in Figure III-21 originate from point sources located in the western parts of East St. Louis (Pfizer, Inc.), Sauget, Illinois (Monsanto) and Missouri point sources along the Mississippi River waterfront (Monsanto, Anheuser Busch, National Lead and Titantium, Union Electric-Meramec). Ambient SO_2 levels approach the twenty-four hour AQS of 365 $\mu g/m^3$, but do not exceed it anywhere in the study area under dispersion assumptions (neutral stability conditions). Ambient TSP as well as SO_2 levels in the central and eastern sections of the study area are moderately low under dispersion conditions where projected Corps of Engineers construction is to take place.

HIGHWAY GENERATED AIR POLLUTION LEVELS IN THE BOTTOMLANDS OF THE CAHOKIA CANAL AREA

The Cahokia Canal Bottomlands area is crossed by a number of important interstate, federal, and state highways which focus on St. Louis. The highways which are characterized by the heaviest traffic are Interstates 55/70 and 270. A number of federal and state highways serve the area, with the federal highways, which are essentially east-west routes, focusing on St. Louis also. The state highways are mainly north-south routes which provide local linkages among the various communities in Illinois known collectively as Metro-East across the Mississippi River from St. Louis. The county highways also serve to strengthen the local linkages throughout Metro-East.

The highways in the Cahokia Canal bottomlands area that bear sufficiently large amounts of traffic to be considered in the context of air pollution are listed in Table III-18. The location and pattern of these highways can be seen in Figure III-1. Both interstates carry large volumes of commercial, intercity diesel-powered trailer-tractor rigs because of the significance of St. Louis in interstate truck transportation. In addition, both interstates are conduits for large numbers of gasoline powered trucks, most of which are intracity commercial carriers. For these reasons, Interstate 55/70 and Interstate 270 generate large amounts of carbon monoxide (CO). Illinois Highways 157, 111, and 203 along with U.S. Highway 3 are the only north-south routes in the area and thus carry significant amounts of automobile traffic, but do not bear the truck traffic

Table III-18

Listing of Cahokia Canal Bottomland Area Highways
Producing Significant Amounts of Carbon Monoxide

Interstate 270

Interstate 55/70

Illinois Highway 157

Illinois Highway 111

Illinois Highway 203

U.S. Highway 3

Illinois Highway 162

County Highway 35

County Highway 772

Source: Atlas & Plat Book, Madison Co., Illinois, Rockford Map Publishers, Inc., Rockford, Illinois, 1973 of the interstates. Illinois Highway 162 and County Highways 35 and 772 are included because they lead to Granite City, the most important industrial community of Metro-East, and consequently, are fairly significant routes of commuter traffic.

Methodology and Data Acquisition

The format and methodology used in this section follows the Illinois Department of Transportation Air Quality Manual (Vik and Byers, 1978). This manual in turn is based on the form contained in Volume 7, Sections 2 and 9 in the Federal-Aid Highway Program Manual (Federal Highway Administration). The Illinois DOT Air Quality Manual contains revised emission factors which take into consideration Federal Test Procedures in the Federal EPA publication 400/9-78-006; Mobile Source Emission Factors.

All data concerning traffic volumes, mix and other salient factors for the Cahokia Canal Area was acquired from the Planning Section, Illinois Department of Transportation (Belleville, Illinois). As stated above, emission factors (Appendix B) and diffusion factors for the worst possible cases (Chapter 7) were acquired from the Illinois DOT Air Quality Manual. Table III-19 is the format suggested by the Illinois DOT Air Quality Manual and will be utilized in following sections.

The term "worst case" is used to reduce highway air quality analysis to minimum calculations. The worst case occurs under worst probable conditions or whenever a wind speed of two and two tenths miles per hour, a wind direction of twenty-two and five tenths degrees relative to highway orientation and a condition known as

Table III-19

Data For Worst Case Calculations

Item	Year of Interest: Current Year	Year of Interest: Design Year
ADT		
8 Hour Maximum Hourly Volume		
Average Speed		
Receptor Distance		
Background CO		
Total CO Concentration		

Source: Vik, L.F. and Byers, M.E., Illinois Department of Transportation Air Quality Manual, Illinois Environmental Protection Agency, September, 1977.

class F Pasquill Atmospheric Stability occur together.

All calculations (tables) of ambient CO levels generated by traffic volumes on area highways which appear in the next section assume "worst cases" occurring under worst possible conditions.

The emission factors which are displayed in Appendix B in Tables III-B1 and III-B2 are taken from the Illinois DOT Air Quality Manual. They include such factors as age of vehicles in downstate Illinois, number of vehicles with catalytic converters and a number of hot and cold starts per urban category as well as vehicle speed. The vehicle speeds for each highway assumed in this report for the calculated values of ambient CO levels were suggested by Mr. Kent Lemp, Planning Section, Illinois Department of Highways.

<u>Simulation of Air Pollutant Levels Generated by Cahokia Canal Area Highways</u>

In this section, simulation of only carbon monoxide ambient levels is used to illustrate vehicle relationship to air pollution. There are several reasons for this: 1) in urban areas nearly seventy-three percent of all atmospheric carbon monoxide (CO) by 1970 was due to internal combustion engines mounted in motor vehicles and nearly 100 percent in the central business districts of large metropolitan cities, 2) CO is relatively non-reactive and can be measured and traced with proper instrumentation, and 3) because CO is non-reactive, it is suitable for a large number of non-reactive diffusion models. It should be noted that motor vehicles are accountable also for fifty percent of nitrogen oxides and fifty-six percent of all hydrocarbons in the average large city.[6] But these pollutants are highly reactive and consequently are not suitable for present diffusion models.

Simulation of air quality as illustrated by ambient CO is accomplished only for the rural areas of the Cahokia Canal Area bottomlands. This was done owing to the fact that most of the Corps construction activity will take place in rural areas far away from urbanized development. Secondly, CO is monitored in two locations in Granite City, which is the only large urban area within the Cahokia Canal Area to generate sufficient ambient CO levels of concern. In the case of downstate Illinois it has been observed that population centers of less than 50,000 do not usually experience motor vehicle generated CO pollution problems and Granite City is the only population center to approach 50,000[7]. Background CO levels utilized in this section are those suggested by Vik and Byers. Accordingly, one part per million (ppm) of CO is added to simulated ambient CO levels in rural areas and two ppm may be added whenever the highway cuts through an urban area of 5,000 population or more[8]. As is shown by Figure III-9, even within the vicinity of Granite City Steel, point source background levels do not exceed 436 micrograms/meter^3 or four tenths ppm of ambient CO. Using the above mentioned two factors, it is felt that using background levels of one ppm in rural areas and two ppm in urban areas is a liberal amount to add to the simulated ambient CO levels in the Cahokia Canal Area and will yield predicted values that are higher than the actual case.

The one hour average of the eight hour maximum volume of traffic by highway is shown in Table III-20. As mentioned earlier, the interstates have the heaviest volume of traffic and account for almost one-half of total traffic volume listed in Table III-20. Percent of

Table III-20

One Hour Average of Most Heavily Travelled
Eight Hour Period by Highway

Highway	Average One Hour Traffic Flow
Interstate 270	2052 Vehicles/Hour
Interstate 55/70	1712 Vehicles/Hour
Highway 157	961 Vehicles/Hour
Highway 111	825 Vehicles/Hour
Highway 203	816 Vehicles/Hour
Highway 3	727 Vehicles/Hour
Highway 162	260 Vehicles/Hour
County Highway 35	377 Vehicles/Hour
County Highway 772	110 Vehicles/Hour

Source: Illinois Department of Transportation, Planning Section, Belleville, Illinois.

vehicle mix (by category) is depicted in Table III-21. Again the interstate routes are conspicuous because of the relatively high percentage of diesel powered trucks when compared to the state and federal highways.

Tables III-22 through III-30 are included to display the most heavily travelled eight hour periods for the nine highway routes and the proportion of traffic each eight hour block accounts for. As can be seen, the eight hour period extends from 1000 to 1700 or 1100 to 1800 hours. All of the eight hour time blocks account for percentages close to fifty percent and Highways 157, 203, 162 and 111 have eight hour blocks that account for fifty percent or more.

Tables III-31 through III-39 are included to show how predicted ambient CO levels were calculated from average daily traffic flow under the assumptions of worst probable conditions mentioned and described earlier. The worst case ambient CO levels predicted for each highway at five feet distance in these tables range from a maximum value of five and three hundred eighty-six thousandths ppm in 1979 and four and eight hundred twenty-five thousandths ppm in 1982 for Interstate 270 to a minimum value of one and five hundred twelve thousandths ppm in 1979 and one and four hundred twenty-six thousandths ppm in 1982 for County Highway 772. In every case, each highway included in this report produces less than the Eight Hour EPA Air Quality Standard (nine ppm CO) and the One Hour Air Quality Standard (thirty-five ppm CO) under the worst probable conditions at only five feet distance. If the urban background ambient CO levels of two ppm suggested by Vik and Byers is added to each of the nine highways predicted ambient CO levels, the worst case values

Table III-21

Percent of Vehicle Mix by Category of Vehicle

Highway	Automobiles & Light Duty Gasoline-Powered Trucks	Heavy Duty Gasoline-Powered Trucks	Heavy Duty Diesel-Powered Trucks
Interstate 270	89	4	7
Interstate 55/70	89	4	7
Highway 157	94	4	2
Highway 111	94	4	2
Highway 203	94	4	2
Highway 3	94	4	2
Highway 162	94	4	2
County Highway 35	95	3	2
County Highway 772	95	3	2

Source: Federal Highway Administration, FHWA Technical Advisory T 5040.1, U.S. Department of Transportation, April 3, 1978.

Table III-22

Interstate 270 (ADT = 33,481)
Most Heavily Travelled Eight Hour Period

Hour	Traffic Flow	Percent of ADT
1100	1612	4.8
1200	1704	5.1
1300	1756	5.3
1400	2049	6.1
1500	2390	7.1
1600	2602	7.8
1700	2378	7.1
1800	1930	5.8
	16,421	49.1

Table III-23

Interstate 55/70 (ADT = 29,207)
Most Heavily Travelled Eight Hour Period

Hour	Traffic Flow	Percent of ADT
1000	1743	6.0
1100	1620	5.5
1200	1553	5.3
1300	1362	4.7
1400	1789	6.1
1500	1803	6.2
1600	2371	8.1
1700	1457	5.0
	13,698	46.9

Source: Calculations by author using Illinois DOT Planning Section (Belleville District) data.

Table III-24

U.S. Highway 3 (ADT = 12,200)
Most Heavily Travelled Eight Hour Period

Hour	Traffic Flow	Percent of ADT
1000	720	4.9
1100	764	5.2
1200	764	5.2
1300	756	5.2
1400	1088	7.4
1500	1367	9.3
1600	1176	8.0
1700	1044	7.1
	7679	47.7

Table III-25

U.S. Highway 111 (ADT = 13,200)
Most Heavily Travelled Eight Hour Period

Hour	Traffic Flow	Percent of ADT
1000	607	4.6
1100	568	4.3
1200	805	6.1
1300	713	5.4
1400	871	6.6
1500	950	7.2
1600	1218	9.2
1700	871	6.6
	6603	50.0

Source: Calculations by author using Illinois DOT Planning Section (Belleville District) data.

Table III-26

U.S. Highway 203 (ADT = 12,600)
Most Heavily Travelled Eight Hour Period

Hour	Traffic Flow	Percent of ADT
1000	529	4.2
1100	756	6.0
1200	693	5.5
1300	844	6.7
1400	907	6.2
1500	1172	9.3
1600	819	6.5
1700	806	6.4
	6526	51.8

Table III-27

County Highway 3 (ADT = 12,200)
Most Heavily Travelled Eight Hour Period

Hour	Traffic Flow	Percent of ADT
1100	624	5.2
1200	635	5.2
1300	635	5.2
1400	903	7.4
1500	976	8.0
1600	1135	9.3
1700	866	7.1
1800	671	5.5
	5819	47.7

Source: Calculations by author using Illinois DOT Planning Section (Belleville District) data.

Table III-28

U.S. Highway 162 (ADT = 4,001)
Most Heavily Travelled Eight Hour Period

Hour	Traffic Flow	Percent of ADT
1100	249	4.3
1200	348	6.1
1300	312	5.4
1400	379	6.6
1500	413	7.2
1600	535	9.2
1700	379	6.6
1800	371	6.5
	2076	51.9

Table III-29

County Highway 35 (ADT = 6,100)
Most Heavily Travelled Eight Hour Period

Hour	Traffic Flow	Percent of ADT
1000	293	4.8
1100	311	5.1
1200	305	5.0
1300	299	4.9
1400	390	6.4
1500	500	8.2
1600	493	8.1
1700	421	6.9
	3012	49.4

Source: Calculations by author using Illinois DOT Planning Section (Belleville District) data.

Table III-30

County Highway 772 (ADT = 1,760)
Most Heavily Travelled Eight Hour Period

Hour	Traffic Flow	Percent of ADT
1000	79	4.5
1100	74	4.2
1200	104	5.9
1300	97	5.5
1400	113	6.4
1500	128	7.3
1600	164	9.3
1700	119	6.8
	878	49.9

Source: Calculations by author using Illinois DOT Planning Section (Belleville District) data.

Table III-31

Calculations of Ambient CO Concentrations Produced
by Traffic Flow on Interstate 270 at a Receptor Distance of Five Feet

Vehicle Flow

Year	Eight Hour	One Hour Average
1979	(.491)·(33,481) = 16,421	16,421/8 = 2053
1980	(.491)·(34,151) = 16,768	16,768/8 = 2096
1981	(.491)·(34,834) = 17,103	17,103/8 = 2138
1982	(.491)·(34,430) = 17,445	17,445/8 = 2180

Composite Emission Factors (See Tables III-B1, III-B2, & III-B3)

Year	Average Speed of Vehicle		Percent Cars		Emission Factor		Percent Gasoline Trucks		Emission Factor		Percent Diesel Trucks		Emission Factor		C.E.F.
1979	55 mph	=	(0.89)	·	(17.8)	+	(0.04)	·	(156.4)	+	(0.07)	·	(12.4)	=	22.9
1980	55 mph	=	(0.89)	·	(16.2)	+	(0.04)	·	(157.2)	+	(0.07)	·	(11.8)	=	21.5
1981	55 mph	=	(0.89)	·	(14.5)	+	(0.04)	·	(159.5)	+	(0.07)	·	(11.3)	=	20.1
1982	55 mph	=	(0.89)	·	(13.0)	+	(0.04)	·	(161.6)	+	(0.07)	·	(11.0)	=	18.8

Source: Values calculated by author using HIWAY model.

Table III-31 Continued

Year			Vehicles/ Hour		C.E.F.		Q
1979	(1.73×10^{-7})	•	(2053)	•	(22.9)	=	0.00813
1980	(1.73×10^{-7})	•	(2096)	•	(21.5)	=	0.00779
1981	(1.73×10^{-7})	•	(2138)	•	(20.1)	=	0.00743
1982	(1.73×10^{-7})	•	(2180)	•	(18.8)	=	0.00709

CO Ambient Concentrations at Five Feet Distance (See Table III-A1)

Year	Concentration Factor (ppm)		Q		Predicted ppm		Background ppm	
1979	(539.5)	•	(0.00813)	=	4.386	+	1.0	= 5.386 ppm
1980	(539.5)	•	(0.00779)	=	4.203	+	1.0	= 5.203 ppm
1981	(539.5)	•	(0.00743)	=	4.008	+	1.0	= 5.008 ppm
1982	(539.5)	•	(0.00709)	=	3.825	+	1.0	= 4.825 ppm

Table III-32

Calculations of Ambient CO Concentrations
Produced by Traffic Flow on Interstate 55/70 at a Receptor Distance of Five Feet

Vehicle Flow

Year	Eight Hour	One Hour Average
1979	(.469)•(29,207) = 13,698	13,698/8 = 1712
1980	(.469)•(29,791) = 13,972	13,972/8 = 1747
1981	(.469)•(30,387) = 14,252	14,252/8 = 1782
1982	(.469)•(03,995) = 14,537	14,537/8 = 1817

Composite Emission Factors (see Tables III-B1, III-B2 & III-B3)

Year	Average Speed of Vehicle		Percent Cars		Emission Factor		Percent Gasoline Trucks		Emission Factor		Percent Diesel Trucks		Emission Factor		C.E.F.
1979	55 mph	=	(0.89)	•	(17.8)	+	(0.04)	•	(156.4)	+	(0.07)	•	(12.4)	=	22.9
1980	55 mph	=	(0.89)	•	(16.2)	+	(0.04)	•	(157.2)	+	(0.07)	•	(11.8)	=	21.5
1981	55 mph	=	(0.89)	•	(14.5)	+	(0.04)	•	(159.5)	+	(0.07)	•	(11.3)	=	20.1
1982	55 mph	=	(0.89)	•	(13.0)	+	)0.04)	•	(161.6)	+	(0.07)	•	(11.0)	=	18.8

Source: Values calculated by author using HIWAY model.

Table III-32 Continued

Values for $Q = (1.73 \times 10^{-7})$(Vehicles/Hour (C.E.F.))

Year			Vehicles/ Hour		C.E.F.	Q
1979	(1.73×10^{-7})	·	(1712)	·	(22.9)	0.00678
1980	(1.73×10^{-7})	·	(1746)	·	(21.5)	0.00649
1981	(1.73×10^{-7})	·	(1781)	·	(20.1)	0.00619
1982	(1.73×10^{-7})	·	(1817)	·	(18.8)	0.00591

CO Ambient Concentrations at Five Feet Distance (see Table III-A1)

Year	Concentration Factor (ppm)		Q		Predicted ppm		Background ppm	
1979	(539.5)	·	(0.00678)	=	3.658	+	1.0	= 4.658
1980	(539.5)	·	(0.00649)	=	3.501	+	1.0	= 4.501
1981	(539.5)	·	(0.00619)	=	3.339	+	1.0	= 4.339
1982	(539.5)	·	(0.00591)	=	3.188	+	1.0	= 4.188

Table III-33

Calculations of Ambient CO Concentrations
Produced by Traffic Flow on Illinois Highway 157 at a Receptor Distance of Five Feet

Vehicle Flow

Year	Eight Hour	One Hour Average
1979	(.523)·(7689) = 4021	7689/8 = 961
1980	(.523)·(7843) = 4102	7843/8 = 980
1981	(.523)·(7999) = 4184	7995/8 = 1000
1982	(.523)·(8160) = 4267	8160/8 = 1020

Composite Emission Factors (see Tables III-B1, III-B2, & III-B3)

Year	Average Speed of Vehicle		Percent Cars		Emission Factor		Percent Gasoline Trucks		Emission Factor		Percent Diesel Trucks		Emission Factor		C.E.F.
1979	40 mph	=	(0.94)	·	(21.4)	+	(0.04)	·	(145.6)	+	(0.02)	·	(14.2)	=	26.2
1980	40 mph	=	(0.94)	·	(19.3)	+	(0.04)	·	(149.0)	+	(0.02)	·	(13.7)	=	24.4
1981	40 mph	=	(0.94)	·	(17.2)	+	(0.04)	·	(152.9)	+	(0.02)	·	(13.3)	=	22.6
1982	40 mph	=	(0.94)	·	(15.4)	+	(0.04)	·	(156.8)	+	(0.02)	·	(13.0)	=	21.0

Source: Values calculated by author using HIWAY model.

Table III-33 Continued

Values for $Q = (1.73 \times 10^{-7})$ (Vehicles/Hour) (C.E.F)

Year			Vehicles/ Hour		C.E.F.		Q
1979	(1.73×10^{-7})	•	(961)	•	(26.2)	=	0.00444
1980	(1.73×10^{-7})	•	(980)	•	(24.4)	=	0.00414
1981	(1.73×10^{-7})	•	(1000)	•	(22.6)	=	0.00391
1982	(1.73×10^{-7})	•	(1020)	•	(21.0)	=	0.00371

CO Ambient Concentrations at Five Feet Distance (see Table III-A1)

Year	Concentration Factor (ppm)		Q		Predicted ppm		Background ppm	
1979	(539.5)	•	(0.00444)	=	2.395	+	1.0	= 3.395
1980	(539.5)	•	(C.00414)	=	2.179	+	1.0	= 3.179
1981	(539.5)	•	(0.00391)	=	2.109	+	1.0	= 3.109
1982	(539.5)	•	(0.00371)	=	2.002	+	1.0	= 3.002

Table III-34

Calculations of Ambient CO Concentration Produced by
Traffic Flow on Illinois Highway 111 at a Receptor Distance of Five Feet

Vehicle Flow

Year	Eight Hour	One Hour Average
1979	(.5)•(13,200) = 6600	6600/8 = 825
1980	(.5)•(13,464) = 6732	6732/8 = 842
1981	(.5)•(13,733) = 6867	6867/8 = 858
1982	(.5)•(14,008) = 7004	7004/8 = 876

Composite Emission Factors (see Tables III-B1, III-B2, & III-B3)

Year	Average Speed of Vehicle		Percent Cars		Emission Factor		Percent Gasoline Trucks		Emission Factor		Percent Diesel Trucks		Emission Factor		C.E.F.
1979	40 mph	=	(0.94)	•	(21.4)	+	(0.04)	•	(145.6)	+	(0.02)	•	(14.2)	=	26.2
1980	40 mph	=	(0.94)	•	(19.3)	+	(0.04)	•	(149.0)	+	(0.02)	•	(13.7)	=	24.4
1981	40 mph	=	(0.94)	•	(17.2)	+	(0.04)	•	(152.9)	+	(0.02)	•	(13.3)	=	22.6
1982	40 mph	=	(0.94)	•	(15.4)	+	(0.04)	•	(156.8)	+	(0.02)	•	(13.0)	=	21.0

Source: Values calculated by author using HIWAY model.

Table III-34 Continued

Values for $Q = (1.73 \times 10^{-7})$ (Vehicles/Hour) (C.E.F.)

Year			Vehicles/ Hour		C.E.F.	Q
1979	(1.73×10^{-7})	·	(825)	·	(26.2)	= 0.00374
1980	(1.73×10^{-7})	·	(842)	·	(24.4)	= 0.00355
1981	(1.73×10^{-7})	·	(856)	·	(22.6)	= 0.00335
1982	(1.73×10^{-7})	·	(876)	·	(21.0)	= 0.00318

CO Ambient Concentrations at Five Feet Distance (see Table III-A1)

Year	Concentration Factor (ppm)		Q		Predicted ppm		Background ppm	
1979	(539.5)	·	(0.00374)	=	2.015	+	1.0	= 3.015
1980	(539.5)	·	(0.00355)	=	1.918	+	1.0	= 2.918
1981	(539.5)	·	(0.00335)	=	1.809	+	1.0	= 2.809
1982	(539.5)	·	(0.00318)	=	1.714	+	1.0	= 2.714

Table III-35

Calculations of Ambient CO Concentrations Produced by Traffic Flow on Illinois Highway 203 at a Receptor Distance of Five Feet

Vehicle Flow

Year	Eight Hour	One Hour Average
1979	(.518)·(12,600) = 6526	6526/8 = 816
1980	(.518)·(12,852) = 6657	6657/8 = 832
1981	(.518)·(13.109) = 6790	6790/8 = 349
1982	(.518)·(13,371) = 6926	6926/8 = 866

Composite Emission Factors (see Tables III-B1, III-B2, & III-B3)

Year	Average Speed of Vehicle		Percent Cars		Emission Factor		Percent Gasoline Trucks		Emission Factor		Percent Diesel Trucks		Emission Factor		C.E.F.
1979	40 mph	=	(0.94)	·	(21.4)	+	(0.04)	·	(145.6)	+	(0.02)	·	(14.2)	=	26.2
1980	40 mph	=	(0.94)	·	(19.3)	+	(0.04)	·	(149.0)	+	(0.02)	·	(13.7)	=	24.4
1981	40 mph	=	(0.94)	·	(17.2)	+	(0.04)	·	(152.9)	+	(0.02)	·	(13.3)	=	22.6
1982	40 mph	=	(0.94)	·	(15.4)	+	(0.04)	·	(156.8)	+	(0.02	·	(13.0)	=	21.0

Source: Values calculated by author using HIWAY model.

Table III-35 Continued

Values for $Q = (1.73 \times 10^{-7})$ (Vehicles/Hour) (C.E.F.)

Year			Vehicles/ Hour		C.E.F.	Q
1979	(1.73×10^{-7})	•	(816)	•	(26.2)	0.00369
1980	(1.73×10^{-7})	•	(832)	•	(24.4)	0.00351
1981	(1.73×10^{-7})	•	(849)	•	(22.6)	0.00332
1982	(1.73×10^{-7})	•	(866)	•	(21.0)	0.00315

CO Ambient Concentrations at Five Feet Distance (see Table III-A1)

Year	Concentration Factor (ppm)		Q		Predicted ppm		Background ppm	
1979	(539.5)	•	(0.00369)	=	1.991	+	1.0	= 2.894
1980	(539.5)	•	(0.00351)	=	1.894	+	1.0	= 2.791
1981	(539.5)	•	(0.00332)	=	1.791	+	1.0	= 2.791
1982	(539.5)	•	(0.00315)	=	1.699	+	1.0	= 2.699

Table III-36

Calculations of Ambient CO Concentration
Produced by Traffic Flow on US Highway 3 at a Receptor Distance of 5 Feet

Vehicle Flow

Year	Eight Hour	One Hour Average
1979	(.477)•(12,200) = 5819	5819/8 = 727
1980	(.477)•(12,400) = 5935	5935/8 = 742
1981	(.477)•(12,693) = 6054	6054/8 = 757
1982	(.477)•(12,947) = 6175	6175/8 = 772

Composite Emission Factors (see Tables III-B1, III-B2, & III-B3)

Year	Average Speed of Vehicle		Percent Cars		Emission Factor		Percent Gasoline Trucks		Emission Factor		Percent Diesel Trucks		Emission Factor		C.E.F.
1979	40 mph	=	(0.94)	•	(21.4)	+	(0.04)	•	(145.6)	+	(0.02)	•	(14.2)	=	26.2
1980	40 mph	=	(0.94)	•	(19.3)	+	(0.04)	•	(149.0)	+	(0.02)	•	(13.7)	=	24.4
1981	40 mph	=	(0.94)	•	(17.2)	+	(0.04)	•	(152.9)	+	(0.02)	•	(13.3)	=	22.6
1982	40 mph	=	(0.04)	•	(15.4)	+	(0.04)	•	(156.8)	+	(0.02)	•	(13.0)	=	21.0

Source: Values calculated by author using HIWAY model.

Table III-36 Continued

Values for $Q = (1.73 \times 10^{-7})$ (Vehicles/Hour) (C.E.F.)

Year			Vehicles/ Hour		C.E.F.	Q
1979	(1.73×10^{-7})	•	(727)	•	(26.2)	= 0.00329
1980	(1.73×10^{-7})	•	(742)	•	(24.4)	= 0.00313
1981	(1.73×10^{-7})	•	(757)	•	(22.6)	= 0.00296
1982	(1.73×10^{-7})	•	(772)	•	(21.0)	= 0.00280

CO Ambient Concentrations at Five Feet Distance (see Table III-A1)

Year	Concentration Factor (ppm)		Q	Predicted ppm		Background ppm	
1979	(539.5)	•	(0.00329) =	1.775	+	1.0	= 2.775
1980	(539.5)	•	(0.00313) =	1.689	+	1.0	= 2.689
1981	(539.5)	•	(0.00296) =	1.597	+	1.0	= 2.597
1982	(539.5)	•	(0.00280) =	1.511	+	1.0	= 2.511

Table III-37

Calculations of Ambient CO Concentrations Produced by Traffic Flow on Highway 162 at a Receptor Distance of Five Feet

Vehicle Flow

Year	Eight Hour	One Hour Average
1979	(.519)·(4001) = 2076	2076/8 = 260
1980	(.519)·(4081) = 2118	2118/8 = 265
1981	(.519)·(4163) = 2161	2161/8 = 270
1982	(.519)·(4246) = 2204	2204/8 = 276

Composite Emission Factors (see Tables III-B1, III-B2, & III-B3)

Year	Average Speed of Vehicle		Percent Cars		Emission Factor		Percent Gasoline Trucks		Emission Factor		Percent Diesel Trucks		Emission Factor		C.E.F.
1979	40 mph	=	(0.94)	·	(21.4)	+	(0.04)	·	(145.6)	+	(0.02)	·	(14.2)	=	26.2
1980	40 mph	=	(0.94)	·	(19.3)	+	(0.04)	·	(149.0)	+	(0.02)	·	(13.7)	=	24.4
1981	40 mph	=	(0.94)	·	(17.2)	+	(0.04)	·	(152.9)	+	(0.02)	·	(13.3)	=	22.6
1982	40 mph	=	(0.94)	·	(15.4)	+	(0.04)	·	(156.8)	+	(0.02)	·	(13.0)	=	21.0

Source: Values calculated by author using HIWAY model.

Table III-37 Continued

Values for $Q = (1.73 \times 10^{-7})$ (Vehicles/Hour) (C.E.F.)

Year			Vehicles/ Hour		C.E.F.	Q
1979	(1.73×10^{-7})	•	(260)	•	(26.2)	= 0.00118
1980	(1.73×10^{-7})	•	(265)	•	(24.4)	= 0.00112
1981	(1.73×10^{-7})	•	(270)	•	(22.6)	= 0.00106
1982	(1.73×10^{-7})	•	(276)	•	(21.0)	= 0.00100

CO Ambient Concentrations at Five Feet Distance (see Table III-A1)

Year	Concentration Factor (ppm)		Q	Predicted ppm		Background ppm	
1979	(539.6)	•	(0.00118) =	0.637	+	1.0	= 1.637
1980	(539.6)	•	(0.00112) =	0.604	+	1.0	= 1.604
1981	(539.6)	•	(0.00106) =	0.572	+	1.0	= 1.572
1982	(539.6)	•	(0.00100) =	0.539	+	1.0	= 1.539

Table III-38

Calculations of Ambient CO Concentrations Produced by Traffic Flow on County Highway 35 at a Receptor Distance of Five Feet

Vehicle Flow

Year	Eight Hour	One Hour Average
1979	(.518)•(6100) = 3160	3160/8 = 395
1980	(.518)•(6222) = 3223	3223/8 = 403
1981	(.518)•(6346) = 3287	3287/8 = 411
1982	(.518)•(6473) = 3353	3353/8 = 419

Composite Emission Factors (see Tables III-B1, III-B2, & III-B3)

Year	Average Speed of Vehicle		Percent Cars		Emisison Factor		Percent Gasoline Trucks		Emission Factor		Percent Diesel Trucks		Emission Factor		C.E.F.
1979	40 mph	=	(0.95)	•	(21.4)	+	(0.03)	•	(145.6)	+	(0.02)	•	(14.2)	=	24.9
1980	40 mph	=	(0.95)	•	(19.3)	+	(0.03)	•	(149.0)	+	(0.02)	•	(13.7)	=	23.1
1981	40 mph	=	(0.95)	•	(17.2)	+	(0.03)	•	(152.9)	+	(0.02)	•	(13.3)	=	21.2
1982	40 mph	=	(0.95)	•	(15.4)	+	(0.03)	•	(156.8)	+	(0.02)	•	(13.0)	=	19.6

Source: Values calculated by author using HIWAY model.

Table III-38 Continued

Values for $Q = (1.73 \times 10^{-7})$ (Vehicles/Hour) (C.E.F.)

Year			Vehicles/ Hour		C.E.F.		Q
1979	(1.73×10^{-7})	•	(395)	•	(24.9)	=	0.00170
1980	(1.73×10^{-7})	•	(403)	•	(23.1)	=	0.00161
1981	(1.73×10^{-7})	•	(411)	•	(21.2)	=	0.00151
1982	(1.73×10^{-7})	•	(419)	•	(19.6)	=	0.00142

CO Ambient Concentrations at Five Feet Distance (see Table III-A1)

Year	Concentration Factor (ppm)		Q		Predicted ppm		Background ppm	
1979	(539.1)	•	(0.00170)	=	0.916	+	1.0	= 1.916
1980	(539.1)	•	(0.00161)	=	0.868	+	1.0	= 1.868
1981	(539.1)	•	(0.00151)	=	0.814	+	1.0	= 1.814
1982	(539.1)	•	(0.00142)	=	0.766	+	1.0	= 1.766

Table III-39

Calculations of Ambient CO Concentrations Produced by Traffic Flow on County Highway 772 at a Receptor Distance of Five Feet

Vehicle Flow

Year	Eight Hour	One Hour Average
1979	(.499)•(3527) = 1760	1760/8 = 220
1980	(.499)•(3597) = 1795	1795/8 = 224
1981	(.499)•(3669) = 1831	1831/8 = 229
1982	(.499)•(3743) = 1868	1868/8 = 234

Composite Emission Factors (see Tables III-B1, III-B2, & III-B3)

Year	Average Speed of Vehicle		Percent Cars		Emission Factor		Percent Gasoline Trucks		Emission Factor		Percent Diesel Trucks		Emission Factor		C.E.F.
1979	40 mph	=	(0.95)	•	(21.4)	+	(0.04)	•	(145.6)	+	(0.02)	•	(14.2)	=	24.9
1980	40 mph	=	(0.95)	•	(19.3)	+	(0.04)	•	(149.0)	+	(0.02)	•	(13.7)	=	23.1
1981	40 mph	=	(0.95)	•	(17.2)	+	(0.04)	•	(152.9)	+	(0.02)	•	(13.3)	=	21.2
1982	40 mph	=	(0.95)	•	(15.4)	+	(0.04)	•	(156.8)	+	(0.02)	•	(13.0)	=	19.6

Source: Values calculated by author using HIWAY model.

Table III-39 Continued

Values for $Q = (1.73 \times 10^{-7})$ (Vehicles/Hour) (C.E.F.)

Year			Vehicles/ Hour		C.E.F.	Q
1979	(1.73×10^{-7})	•	(220)	•	(24.9)	0.00085
1980	(1.73×10^{-7})	•	(224)	•	(23.1)	0.00089
1981	(1.73×10^{-7})	•	(229)	•	(21.2)	0.00084
1982	(1.73×10^{-7})	•	(234)	•	(19.6)	0.00079

CO Ambient Concentrations at Five Feet Distance (see Table III-A1)

Year	Concentration Factor (ppm)		Q		Predicted ppm		Background ppm	
1979	(539.1)	•	(0.00095)	=	0.512	+	1.0	= 1.512
1980	(539.1)	•	(0.00089)	=	0.479	+	1.0	= 1.479
1981	(539.1)	•	(0.00084)	=	0.453	+	1.0	= 1.453
1982	(539.1)	•	(0.00079)	=	0.426	+	1.0	= 1.426

are still less than the Eight Hour Air Quality Standard.

Predicted ambient CO levels for distances ranging from five to 1,000 feet for each of the nine highways are shown in Tables III-40 through III-48. Even in the case of the interstate routes, predict plus background levels of CO are less than half of the eight hour standard at distances of fifty feet or more under worst possible (meteorological) conditions. Army Corps of Engineers construction activity in the rural areas northeast, east and southeast of Granite City in the Cahokia Canal bottomlands area will not alter these values as shown in Tables III-40 through III-48. Vik and Byers state that construction vehicles and machinery, which emit CO, hydrocarbons, and nitrogen oxides, will not significantly alter ambient air concentrations while in operation.

Table III-49 is included to show some of the ambient CO concentrations that occurred in 1977 in Granite City, the most populous urban area in the Cahokia Canal Area. Of the three highest one hour average readings in Granite City, only one of the readings exceeded the Eight Hour Air Quality Standard by a value of four tenths ppm. That eight hour period occurred on October 13 from 0300 to 1400 hours. The One Hour Air Quality Standard (of thirty-five ppm) never was exceeded or even approached. The CO monitoring station at Cahokia Mounds shown in Table III-49 is situated approximately fifty feet from Interstate 55/70 only a few miles west of where that route extends beyond the southern boundary of the Cahokia Canal Area and is located in an area that is transitional in nature between rural and urban

Table III-40

Ambient CO Levels (in ppm) Produced by Traffic Flow on Interstate 270 at Receptor Distances of 5 to 1000 Feet*

Receptor Distance (ft.)	1979 Predicted		1979 Background		1979 Total	1982 Predicted		1982 Background		1982 Total
5	4.386	+	1.0	=	5.386	3.825	+	1.0	=	4.825
10	4.102	+	1.0	=	5.102	3.577	+	1.0	=	4.577
15	3.882	+	1.0	=	4.882	3.385	+	1.0	=	4.385
20	3.683	+	1.0	=	4.683	3.211	+	1.0	=	4.211
25	3.566	+	1.0	=	4.566	3.109	+	1.0	=	4.109
30	3.431	+	1.0	=	4.431	2.991	+	1.0	=	3.991
40	3.264	+	1.0	=	4.264	2.847	+	1.0	=	3.847
50	3.098	+	1.0	=	4.098	2.701	+	1.0	=	3.701
60	2.979	+	1.0	=	3.979	2.598	+	1.0	=	3.598
75	2.829	+	1.0	=	3.829	2.467	+	1.0	=	3.467
100	2.679	+	1.0	=	3.679	2.336	+	1.0	=	3.336
150	2.459	+	1.0	=	3.459	2.145	+	1.0	=	3.145
200	2.260	+	1.0	=	3.260	1.971	+	1.0	=	2.971
300	2.175	+	1.0	=	3.175	1.897	+	1.0	=	2.897
400	2.089	+	1.0	=	3.089	1.822	+	1.0	=	2.822
800	1.846	+	1.0	=	2.846	1.609	+	1.0	=	2.609
1000	1.760	+	1.0	=	2.760	1.535	+	1.0	=	2.535

Year of Interest: 1979, 1982

*Assumes an average daily volume of 33,481 vehicles, 16,421 vehicle maximum flow from 1100 to 1800 hours, an average speed of 55 miles per hour and a CO level of one part per million (ppm)

Source: Calculations by author using HIWAY model.

Table III-41

Ambient CO Levels (in ppm) Produced by Traffic Flow on Interstate 55/70 at Receptor Distances of 5 to 1000 Feet*

	Year of Interest									
	1979					1982				
Receptor Distance (ft.)	Predicted		Background		Total	Predicted		Background		Total
5	3.658	+	1.0	=	4.658	3.188	+	1.0	=	4.188
10	3.421	+	1.0	=	4.421	2.982	+	1.0	=	3.982
15	3.237	+	1.0	=	4.237	2.822	+	1.0	=	3.822
20	3.071	+	1.0	=	4.071	2.677	+	1.0	=	3.677
24	2.973	+	1.0	=	3.973	2.592	+	1.0	=	3.592
30	2.861	+	1.0	=	3.861	2.494	+	1.0	=	3.494
40	2.722	+	1.0	=	31722	2.373	+	1.0	=	3.373
50	2.583	+	1.0	=	3.583	2.252	+	1.0	=	3.252
60	2.485	+	1.0	=	3.485	2.166	+	1.0	=	3.166
75	2.359	+	1.0	=	3.359	2.057	+	1.0	=	3.057
100	2.234	+	1.0	=	3.234	1.947	+	1.0	=	2.947
150	2.051	+	1.0	=	3.051	1.788	+	1.0	=	2.788
200	1.885	+	1.0	=	2.885	1.643	+	1.0	=	2.643
300	1.814	+	1.0	=	2.814	1.581	+	1.0	=	2.581
400	1.742	+	1.0	=	2.742	1.519	+	1.0	=	2.519
800	1.539	+	1.0	=	2.539	1.342	+	1.0	=	2.342
1000	1.464	+	1.0	=	2.464	1.279	+	1.0	=	2.279

*Assumes an average daily volume of 29,207 vehicles, 13,699 vehicle maximum flow from 1100 to 1800 hours, an average speed of 55 miles per hour and a background CO level of one part per million (ppm).

Source: Calculations by author using HIWAY model.

Table III-42

Ambient CO Levels (in ppm) Produced by Traffic Flow on Illinois Highway 157 at Receptor Distances of 5 to 1000 Feet*

	Year of Interest									
	1979					1982				
Receptor Distance (ft.)	Predicted		Background		Total	Predicted		Background		Total
5	2.395	+	1.0	=	3.395	2.002	+	1.0	=	3.002
10	2.239	+	1.0	=	3.239	1.872	+	1.0	=	2.872
14	2.120	+	1.0	=	3.120	1.772	+	1.0	=	2.772
20	2.011	+	1.0	=	3.011	1.681	+	1.0	=	2.681
25	1.947	+	1.0	=	2.947	1.627	+	1.0	=	2.627
30	1.874	+	1.0	=	2.874	1.566	+	1.0	=	2.566
40	1.783	+	1.0	=	2.783	1.489	+	1.0	=	2.489
50	1.692	+	1.0	=	2.692	1.414	+	1.0	=	2.414
60	1.627	+	1.0	=	2.627	1.359	+	1.0	=	2.359
75	1.545	+	1.0	=	2.545	1.291	+	1.0	=	2.291
100	1.463	+	1.0	=	2.463	1.222	+	1.0	=	2.222
150	1.343	+	1.0	=	2.343	1.122	+	1.0	=	2.122
200	1.234	+	1.0	=	2.234	1.031	+	1.0	=	2.031
300	1.188	+	1.0	=	2.188	0.002	+	1.0	=	1.002
400	1.141	+	1.0	=	2.141	0.053	+	1.0	=	1.053
800	1.008	+	1.0	=	2.008	0.842	+	1.0	=	1.842
1000	0.961	+	1.0	=	1.961	0.803	+	1.0	=	1.803

*Assumes an average daily volume of 14,700 vehicles, 7689 vehicle maximum flow from 1000 to 1700 hours, an average speed of 40 miles per hour and a background CO level of one part per million (ppm).

Source: Calculations by author using HIWAY model.

Table III-43

Ambient CO Levels (in ppm) Produced by Traffic Flow on Illinois Highway 111 for Receptor Distances of 5 to 1000 Feet*

Receptor Distance (ft.)	1979 Predicted		1979 Background		1979 Total	1982 Predicted		1982 Background		1982 Total
5	2.015	+	1.0	=	3.015	1.714	+	1.0	=	2.714
10	1.887	+	1.0	=	2.887	1.604	+	1.0	=	2.604
15	1.786	+	1.0	=	2.786	1.518	+	1.0	=	2.518
20	1.694	+	1.0	=	2.694	1.440	+	1.0	=	2.440
25	1.639	+	1.0	=	2.639	1.394	+	1.0	=	2.394
30	1.578	+	1.0	=	2.578	1.342	+	1.0	=	2.342
40	1.502	+	1.0	=	2.502	1.277	+	1.0	=	2.277
50	1.425	+	1.0	=	2.425	1.212	+	1.0	=	2.212
60	1.371	+	1.0	=	2.371	1.165	+	1.0	=	2.165
75	1.302	+	1.0	=	2.302	1.107	+	1.0	=	2.107
100	1.232	+	1.0	=	2.232	1.048	+	1.0	=	2.048
150	1.131	+	1.0	=	2.131	0.962	+	1.0	=	1.962
200	1.040	+	1.0	=	2.040	0.884	+	1.0	=	1.884
300	1.000	+	1.0	=	2.000	0.851	+	1.0	=	1.851
400	0.961	+	1.0	=	1.961	0.817	+	1.0	=	1.817
800	0.848	+	1.0	=	1.848	0.722	+	1.0	=	1.722
1000	0.809	+	1.0	=	1.809	0.657	+	1.0	=	1.657

*Assumes an average daily volume of 13,200 vehicles, 6603 vehicle maximum flow from 1000 to 1700 hours, an average speed of 40 miles per hour and a background CO level of one part per million (ppm).

Source: Calculations by author using HIWAY model.

Table III-44

Ambient CO Levels (in ppm) Produced by Traffic Flow
on Illinois Highway 203 for Receptor Distances of 5 to 1000 Feet*

	Year of Interest									
	1979					1982				
Receptor Distance (ft.)	Predicted		Background		Total	Predicted		Background		Total
5	1.991	+	1.0	=	2.991	1.699	+	1.0	=	2.699
10	1.861	+	1.0	=	2.991	1.589	+	1.0	=	2.589
15	1.762	+	1.0	=	2.861	1.504	+	1.0	=	2.504
20	1.672	+	1.0	=	2.762	1.427	+	1.0	=	2.427
25	1.616	+	1.0	=	2.616	1.381	+	1.0	=	2.381
30	1.557	+	1.0	=	2.557	1.329	+	1.0	=	2.329
40	1.482	+	1.0	=	2.487	1.265	+	1.0	=	2.265
50	1.406	+	1.0	=	2.406	1.200	+	1.0	=	2.200
60	1.352	+	1.0	=	2.352	1.154	+	1.0	=	2.154
75	1.284	+	1.0	=	2.284	1.096	+	1.0	=	2.096
100	1.216	+	1.0	=	2.216	1.038	+	1.0	=	2.038
150	1.116	+	1.0	=	2.116	0.953	+	1.0	=	1.953
200	0.026	+	1.0	=	1.026	0.876	+	1.0	=	1.876
300	0.987	+	1.0	=	1.987	0.843	+	1.0	=	1.843
400	0.948	+	1.0	=	1.948	0.809	+	1.0	=	1.809
800	0.838	+	1.0	=	1.838	0.715	+	1.0	=	1.715
1000	0.799	+	1.0	=	1.799	0.680	+	1.0	=	1.680

*Assumes an average daily volume of 12,600 vehicles per hour, 6626 vehicles maximum flow from 1000 to 1700 hours, an average speed of 40 miles per hour and a background CO level of one part per million (ppm).

Source: Calculations by author using HIWAY model.

Table III-45

Ambient CO Levels (in ppm) Produced by Traffic Flow on Illinois Highway 3 for Receptor Distances of 5 to 1000 Feet*

	Year of Interest										
	1979					1982					
Receptor Distance (ft.)	Predicted		Background		Total	Predicted		Background		Total
5	1.775	+	1.0	=	2.775	1.511	+	1.0	=	2.511
10	1.659	+	1.0	=	2.659	1.413	+	1.0	=	2.413
15	1.571	+	1.0	=	2.571	1.337	+	1.0	=	2.337
20	1.490	+	1.0	=	2.490	1.268	+	1.0	=	2.368
25	1.443	+	1.0	=	2.443	1.228	+	1.0	=	2.228
30	1.388	+	1.0	=	2.388	1.182	+	1.0	=	2.182
40	1.321	+	1.0	=	2.321	1.124	+	1.0	=	2.124
50	1.253	+	1.0	=	2.253	1.067	+	1.0	=	2.067
60	1.205	+	1.0	=	2.205	1.026	+	1.0	=	2.026
75	1.145	+	1.0	=	2.145	0.974	+	1.0	=	1.974
100	1.084	+	1.0	=	2.084	0.923	+	1.0	=	1.923
150	0.995	+	1.0	=	1.995	0.847	+	1.0	=	1.847
200	0.914	+	1.0	=	1.914	0.778	+	1.0	=	1.778
300	0.880	+	1.0	=	1.990	0.749	+	1.0	=	1.749
400	0.846	+	1.0	=	1.846	0.719	+	1.0	=	1.719
800	0.747	+	1.0	=	1.747	0.636	+	1.0	=	1.636
1000	0.712	+	1.0	=	1.712	0.606	+	1.0	=	1.606

*Assumes an average daily volume of 12,200 vehicles, 5819 vehicle maximum flow, an average speed of 40 miles per hour, and a background CO level of one part per million (ppm).

Source: Calculations by author using HIWAY model.

Table III-46

Ambient CO Levels (in ppm) Produced by Traffic Flow on Illinis Highway 162 for Receptor Distances of 5 to 1000 Feet*

Receptor Distance (ft.)	1979 Predicted		1979 Background	1979 Total	1982 Predicted		1982 Background	1982 Total
5	0.637	+	1.0	= 1.637	0.539	+	1.0	= 1.539
10	0.595	+	1.0	= 1.595	0.505	+	1.0	= 1.505
15	0.563	+	1.0	= 1.563	0.478	+	1.0	= 1.478
20	0.535	+	1.0	= 1.535	0.453	+	1.0	= 1.453
25	0.517	+	1.0	= 1.517	0.439	+	1.0	= 1.439
30	0.498	+	1.0	= 1.498	0.422	+	1.0	= 1.422
40	0.474	+	1.0	= 1.474	0.402	+	1.0	= 1.402
50	0.449	+	1.0	= 1.449	0.391	+	1.0	= 1.391
60	0.432	+	1.0	= 1.432	0.367	+	1.0	= 1.367
75	0.411	+	1.0	= 1.411	0.348	+	1.0	= 1.348
100	0.389	+	1.0	= 1.389	0.329	+	1.0	= 1.329
150	0.369	+	1.0	= 1.369	0.313	+	1.0	= 1.313
200	0.328	+	1.0	= 1.328	0.278	+	1.0	= 1.278
300	0.316	+	1.0	= 1.316	0.268	+	1.0	= 1.268
400	0.303	+	1.0	= 1.303	0.257	+	1.0	= 1.257
800	0.268	+	1.0	= 1.268	0.227	+	1.0	= 1.227
1000	0.255	+	1.0	= 1.255	0.217	+	1.0	= 1.217

*Assumes an average daily volume of 4001 vehicles, 2076 vehicle maximum flow from 1100 to 1800 hours, an average speed of 40 miles per hour and a background CO level of one part per million (ppm).

Source: Calculations by author using HIWAY model.

Table III-47

Ambient CO Levels (in ppm) Produced by Traffic Flow
on County Highway 35 at Receptor Distances of 5 to 1000 Feet*

	Year of Interest										
	1979					1982					
Receptor Distance (ft.)	Predicted		Background		Total	Predicted		Background		Total
5	0.916	+	1.0	=	1.916	0.766	+	1.0	=	1.766
10	0.858	+	1.0	=	0.858	0.716	+	1.0	=	1.716
15	0.812	+	1.0	=	1.812	0.678	+	1.0	=	1.678
20	0.770	+	1.0	=	1.770	0.643	+	1.0	=	1.643
25	0.745	+	1.0	=	1.745	0.623	+	1.0	=	1.623
30	0.717	+	1.0	=	1.717	0.599	+	1.0	=	1.599
40	0.683	+	1.0	=	1.683	0.570	+	1.0	=	1.570
50	0.648	+	1.0	=	1.648	0.541	+	1.0	=	1.541
60	0.623	+	1.0	=	1.623	0.520	+	1.0	=	1.520
75	0.592	+	1.0	=	1.592	0.494	+	1.0	=	1.494
100	0.560	+	1.0	=	1.560	0.468	+	1.0	=	1.468
150	0.514	+	1.0	=	1.514	0.444	+	1.0	=	1.444
200	0.473	+	1.0	=	1.473	0.429	+	1.0	=	1.429
300	0.455	+	1.0	=	1.455	0.379	+	1.0	=	1.379
400	0.437	+	1.0	=	1.437	0.365	+	1.0	=	1.365
800	0.386	+	1.0	=	1.386	0.322	+	1.0	=	1.322
1000	0.367	+	1.0	=	1.367	0.307	+	1.0	=	1.307

*Assumes an average daily volume of 6100 vehicles, 3013 vehicle maximum flow from 1000 to 1700 hours, an average speed of 40 miles per hour and a background CO level of one part per million (ppm).

Source: Calculations by author using HIWAY model.

Table III-48

Ambient CO Levels (in ppm) Produced by Traffic Flow on County Highway 772 at Receptor Distances of 5 to 1000 Feet*

	Year of Interest									
	1979					1982				
Receptor Distance (ft.)	Predicted		Background		Total	Predicted		Background		Total
5	0.512	+	1.0	=	1.512	0.426	+	1.0	=	1.426
10	0.479	+	1.0	=	1.479	0.399	+	1.0	=	1.399
15	0.454	+	1.0	=	1.454	0.377	+	1.0	=	1.377
20	0.430	+	1.0	=	1.430	0.358	+	1.0	=	1.358
25	0.417	+	1.0	=	1.417	0.346	+	1.0	=	1.346
30	0.400	+	1.0	=	1.400	0.333	+	1.0	=	1.333
40	0.381	+	1.0	=	1.481	0.317	+	1.0	=	1.317
50	0.362	+	1.0	=	1.362	0.301	+	1.0	=	1.301
60	0.348	+	1.0	=	1.348	0.289	+	1.0	=	1.289
75	0.331	+	1.0	=	1.331	0.275	+	1.0	=	1.275
100	0.313	+	1.0	=	1.313	0.269	+	1.0	=	1.269
150	0.287	+	1.0	=	1.287	0.239	+	1.0	=	1.239
200	0.264	+	1.0	=	1.364	0.219	+	1.0	=	1.219
300	0.254	+	1.0	=	1.254	0.211	+	1.0	=	1.211
400	0.244	+	1.0	=	1.244	0.203	+	1.0	=	1.203
800	0.216	+	1.0	=	1.216	0.179	+	1.0	=	1.179
1000	0.206	+	1.0	=	1.206	0. 171	+	1.0	=	1.171

*Assumes an average daily volume of 1760 vehicles, 878 vehicle maximum flow from 1000 to 1700 hours, an average speed of 40 miles per hour and a background CO level of one part per million (ppm).

Source: Calculations by author using HIWAY model.

Table III-49

CARBON MONOXIDE

(Parts per Million)

STATION	ADDRESS	HIGHEST					
		1-Hr Avg			8-Hr Avg		
		1st	2nd	3rd	1st	2nd	3rd
Madison County							
Granite City	2001 Edison	19.0	15.6	13.8	9.4	9.0	8.4
Wood River	54 N. Walcott	9.0	8.0	7.8	5.9	4.9	4.4
St. Clair County							
Cahokia Mounds	Business Rt. 40	11.5	6.6	6.1	5.6	5.1	5.0

Station	Address	Date	Time	# of Readings 9 ppm	Event
Madison County					
Granite City	2011 Edison	Oct 13	0300-1400	1	9.4

Source: Illinois EPA, 1977 Annual Air Quality Report, Division of Air Pollution Control, Ambient Air Monitoring Section, June 1978, p. 101.

land use patterns. As can be seen from Table III-49, three Eight Hour (Average) Readings equalled or exceeded five ppm of CO, but never approached the nine ppm IEPA Eight Hour Air Quality Standard.

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FOOTNOTES

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[2]Air Resource Analysis Section, Revised Climatological Dispersion Model, Illinois Environmental Protection Agency (Division of Air Pollution Control), July 1, 1977.

[3]Air Resource Analysis Section, Air Quality Short Term Model, Illinois Environmental Protection Agency (Division of Air Pollution Control), January, 1976.

[4]University of Harvard Press, Graduate School of Design, (Laboratory for Computer Graphics and Spatial Analysis), SYMAP, Version V, Harvard University, Cambridge, Mass., December, 1971.

[5]Division of Air Pollution Control, Guidelines for the Performance of Air Quality Impact Analysis to be Used in Support of Permit Application, IEPA, Springfield, Illinois, 1977, pp. 18-21.

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[7]J.F. Vik and M.E. Byers, Illinois Department of Transportation, Air Quality Manual, September, 1978, p. 3-1.

[8]J.F. Vik and M.E. Byers, op. cit., p. 6-6.

APPENDIX A

Table III-A1

CO Concentration Factors 22.5 Degrees Wind
One Meter per Second

Receptor Distance (feet)	D Stability	E Stability	F Stability
5	473.5	531.0	539.5
10	432.5	490.0	504.5
15	403.5	465.5	477.5
20	374.5	442.5	453.0
25	352.0	426.0	438.5
30	333.5	411.5	422.0
35	313.0	397.5	411.5
40	302.5	383.0	401.5
45	292.5	370.5	391.0
50	284.0	360.5	381.0
55	276.0	350.0	374.5
60	272.0	340.0	366.5
65	265.5	333.5	360.5
70	259.5	325.0	354.0
75	255.5	319.0	348.0
100	241.0	294.0	329.5
125	234.5	280.0	313.0
150	220.5	267.5	302.5
200	207.0	247.0	278.0
300	189.0	230.0	267.5
400	180.0	216.5	257.0
800	147.0	181.5	227.0
1000	130.0	171.5	216.5

Table III-A2

CO Concentration Factors 45 Degrees Wind
One Meter per Second

Receptor Distance (feet)	D Stability	E Stability	F Stability
5	269.5	288.0	290.5
10	243.0	274.0	276.0
15	225.5	259.5	261.5
20	208.0	247.0	251.0
25	193.5	236.5	241.0
30	183.0	224.5	233.5
35	177.0	216.0	226.5
40	169.0	206.0	220.5
45	162.5	199.5	212.0
50	158.5	191.5	208.0
55	154.5	185.0	204.0
60	150.5	181.0	199.0
65	146.0	177.0	197.5
70	142.0	173.0	195.5
75	138.0	168.5	189.5
100	127.5	158.5	179.0
125	119.5	152.5	173.0
150	117.5	144.0	167.0
200	115.5	138.0	154.5
300	101.0	123.5	144.0
400	95.0	115.5	135.5
800	79.5	99.0	120.0
1000	72.0	93.0	113.0

Table III-A3

CO Concentration Factors 67.5 Degrees Wind
One Meter per Second

Receptor Distance (feet)	D Stability	E Stability	F Stability
5	216.0	226.5	230.5
10	193.5	210.0	218.0
15	175.0	195.5	206.0
20	160.5	185.5	197.5
25	148.0	173.0	189.5
30	140.0	164.5	179.0
35	136.0	158.5	173.0
40	129.5	152.5	167.0
45	123.5	148.0	160.5
50	119.5	142.0	156.5
55	115.5	138.0	152.5
60	111.0	134.0	148.0
65	109.0	131.5	144.0
70	107.0	129.5	142.0
75	105.0	127.5	134.0
100	96.5	121.5	129.5
125	92.5	117.5	125.5
150	88.5	115.5	123.5
200	86.5	109.0	110.5
300	79.0	96.5	109.5
400	73.5	88.5	101.0
800	60.0	77.0	91.0
1000	54.0	72.0	84.5

Table III-A4

CO Concentration Factors 90 Degrees Wind
One Meter per Second

Receptor Distance (feet)	D Stability	E Stability	F Stability
5	183.0	214.0	218.0
10	160.5	195.5	204.0
15	146.0	183.0	191.5
20	134.0	173.0	181.0
25	125.5	160.5	173.0
30	119.5	154.5	162.5
35	113.0	146.0	154.5
40	109.0	140.0	148.0
45	107.0	134.0	140.0
50	105.0	129.5	134.0
55	101.0	125.5	129.5
60	99.0	121.5	125.5
65	98.0	119.5	123.5
70	94.5	117.5	121.5
75	93.5	115.5	119.5
100	88.5	109.0	113.0
125	86.5	105.0	109.0
150	82.5	103.0	105.0
200	80.5	96.5	103.0
300	78.0	88.5	97.0
400	68.0	80.5	92.0
800	55.0	70.5	83.5
1000	49.5	66.0	79.0

APPENDIX B

AD-A099 708 ENVIRONMENTAL RESEARCHERS OF EDWARDSVILLE INC IL F/6 13/2
ENVIRONMENTAL INVENTORY REPORT. EAST ST. LOUIS AND VICINITY, CA--ETC(U)
MAY 81 C A THORNTON DACW43-78-C-0055

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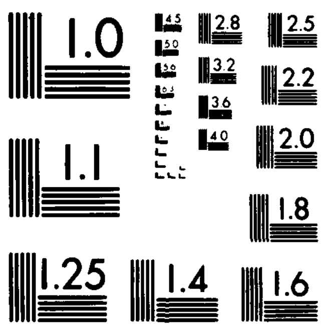

MICROCOPY RESOLUTION TEST CHART

Table III-B1

Light Duty Gasoline Emission Factors for Rural Areas
Plus Towns and Cities Less Than 50,000 Population

Year	Speed 5	10	15	20	25	30	35	40	45	50	55
1978	178.2	87.2	58.7	45.7	37.4	31.0	26.2	23.0	21.4	20.7	19.2
1979	161.9	79.7	54.3	42.6	34.8	28.8	24.3	21.4	19.9	19.2	17.8
1980	144.3	71.4	49.0	38.7	31.7	26.1	22.0	19.3	18.1	17.6	16.2
1981	126.9	63.0	43.6	34.5	29.3	23.3	19.5	17.2	16.1	15.7	14.5
1982	111.8	55.8	38.9	31.0	25.5	20.9	17.5	15.4	14.5	14.2	13.0
1983	96.6	48.6	34.2	27.4	22.5	18.5	15.4	13.6	12.8	12.6	11.6
1984	81.6	41.2	29.2	23.7	19.4	15.9	13.3	11.7	11.1	10.9	10.0
1985	69.7	35.4	25.2	20.4	16.8	13.8	11.5	10.1	9.6	9.5	8.7
1986	59.5	30.4	21.8	17.1	14.6	12.0	10.0	8.8	8.4	8.3	7.6
1987	51.4	26.4	19.1	15.1	12.8	10.5	8.8	7.7	7.4	7.3	6.7
1988	44.9	23.2	16.8	13.8	11.4	9.3	7.8	6.8	6.5	6.5	5.9
1989	39.7	20.6	15.0	12.3	10.2	8.4	7.0	6.1	5.6	5.9	5.3
1990	26.2	18.8	13.8	11.4	9.4	7.7	6.4	5.6	5.4	5.4	4.9
1991	33.2	17.3	12.7	10.5	8.7	7.1	5.9	5.2	5.0	5.0	4.6
1992	30.9	16.1	11.9	9.8	8.2	6.7	5.6	4.9	4.7	4.7	4.3
1993	29.1	15.2	11.3	9.4	7.8	6.4	5.3	4.7	4.5	4.5	4.1
1994	27.7	14.6	10.8	9.0	7.5	6.1	5.1	4.5	4.3	4.4	4.0
1995	27.0	14.2	10.6	8.8	7.3	6.0	5.0	4.4	4.2	4.2	3.9

Rural areas, cities and towns under 50,000 population and all interstates freeway or expressway type highways.

Table III-B2

Heavy Duty Gasoline Emission Factors

Year	Speed 5	10	15	20	25	30	35	40	45	50	55
1978	741.6	500.4	356.8	268.2	212.5	177.2	155.6	143.9	140.4	144.7	158.2
1979	709.2	485.3	350.4	266.4	212.9	178.6	157.4	145.6	141.5	144.8	156.4
1980	666.2	464.1	340.9	263.2	213.2	180.0	160.5	149.0	144.6	147.1	157.2
1981	624.3	443.1	331.3	260.1	213.7	183.3	164.0	152.9	148.5	150.5	159.5
1982	582.6	422.0	321.6	256.8	214.0	185.7	167.5	156.8	152.4	153.8	161.6
1983	531.6	390.8	301.7	243.5	204.8	178.9	162.1	152.1	147.8	148.8	155.5
1984	470.8	349.7	272.5	221.7	187.6	164.7	149.7	140.8	136.7	137.3	143.0
1985	414.1	310.7	244.2	200.0	170.4	150.2	136.9	128.9	125.2	125.6	130.2
1986	362.2	274.6	217.7	179.7	153.8	136.2	124.4	117.2	113.9	114.0	117.8
1987	321.7	246.8	197.5	164.2	141.4	125.6	115.1	108.6	105.4	105.3	108.3
1988	287.4	223.6	180.3	151.0	130.7	116.6	107.1	101.1	98.0	97.7	100.0
1989	259.1	203.6	165.9	139.9	121.6	108.9	100.2	94.6	91.7	91.1	92.9
1990	238.8	289.1	155.2	131.5	114.8	103.0	94.9	89.8	87.1	86.6	88.2
1991	221.3	177.1	146.6	125.0	109.6	98.9	91.3	86.5	84.0	83.5	85.0
1992	206.6	167.2	139.6	119.8	105.7	95.6	88.6	84.0	81.7	81.2	82.6
1993	194.9	159.6	134.3	116.1	102.8	93.3	86.7	82.4	80.1	79.7	81.0
1994	187.2	154.4	130.8	113.5	100.9	91.9	85.5	81.4	79.2	78.8	80.1
1995	179.8	149.4	127.2	110.9	99.0	90.3	84.2	80.3	78.1	77.7	79.0

Table III-B3

Heavy Duty Diesel Emission Factors

	Speed										
Year	5	10	15	20	25	30	35	40	45	50	55
1978	73.3	52.1	38.4	29.4	23.4	19.4	16.6	14.8	13.7	13.1	13.2
1979	71.8	51.0	37.6	28.8	22.9	18.8	16.1	14.2	13.1	12.5	12.4
1980	71.7	50.6	37.1	28.2	22.3	18.3	15.5	13.7	12.5	11.9	11.8
1981	72.1	50.6	36.8	27.9	21.0	17.9	15.1	13.3	12.1	11.5	11.3
1982	72.8	50.7	36.7	27.6	21.6	17.5	14.8	13.0	11.8	11.2	11.0
1983	73.3	50.8	36.6	27.5	21.4	17.3	14.6	12.7	11.6	10.9	10.8
1984	73.7	50.9	36.6	27.3	21.2	17.2	14.4	12.6	11.4	10.8	10.6
1985	74.2	51.1	36.6	27.3	21.1	17.0	14.3	12.5	11.3	10.7	10.5
1986	74.4	51.1	36.6	27.2	21.0	17.0	14.2	12.4	11.2	10.6	10.4
1987	74.6	51.2	36.5	27.2	21.0	16.9	14.1	12.3	11.2	10.5	10.3
1988	74.6	51.2	36.5	27.1	20.9	16.8	14.1	12.3	11.1	10.5	10.3
1989	74.7	51.2	36.5	27.1	20.9	16.8	14.0	12.2	11.1	10.4	10.2
1990	74.7	51.1	36.4	27.0	20.9	16.8	14.0	12.2	11.0	10.4	10.2
1991	74.7	51.1	36.4	27.0	20.8	16.8	14.0	12.2	11.0	10.4	10.2
1992	74.7	51.1	36.4	27.0	20.8	16.7	14.0	12.2	11.0	10.4	10.2
1993	74.7	51.1	36.4	27.0	20.8	16.7	14.0	12.1	11.0	10.4	10.1
1994	74.8	51.2	36.4	27.0	20.8	16.7	14.0	12.1	11.0	10.3	10.1
1995	74.8	51.2	36.4	27.0	20.8	16.7	14.0	12.1	11.0	10.3	10.1

Table III-B4

Light Duty Gasoline Emission Factors

	Speed										
Year	5	10	15	20	25	30	35	40	45	50	55
1978	226.5	113.6	77.5	61.0	50.6	42.8	38.8	32.8	30.6	29.5	27.8
1979	208.8	105.2	72.3	57.2	47.5	40.1	34.5	30.7	28.7	27.8	26.2
1980	188.7	95.4	65.9	52.4	43.6	36.7	31.5	28.1	26.3	25.5	24.0
1981	168.5	85.5	59.3	47.2	39.3	33.1	28.4	25.3	23.8	23.1	21.7
1982	151.0	76.9	53.7	42.9	35.8	30.1	25.8	23.0	21.6	21.1	19.7
1983	133.7	68.4	48.0	38.5	32.1	27.0	23.2	20.7	19.5	19.0	17.8
1984	116.7	60.0	42.3	34.1	28.5	24.0	20.5	18.4	17.3	16.9	15.9
1985	103.4	53.3	37.8	30.5	25.5	21.5	18.4	16.4	15.5	15.2	14.2
1986	91.9	47.6	33.8	27.4	22.9	19.3	16.6	14.8	14.0	13.8	12.8
1987	83.0	43.2	30.8	25.0	20.0	17.6	15.1	13.5	12.8	12.6	11.8
1988	75.9	39.6	28.3	23.0	19.3	16.3	13.9	12.5	11.8	11.6	10.9
1989	70.2	36.7	26.3	21.4	18.0	15.2	13.0	11.6	11.1	10.9	10.2
1990	66.3	34.7	24.9	20.3	17.1	14.4	12.4	11.1	10.5	10.4	9.7
1991	63.1	33.1	23.8	19.4	16.3	13.8	11.8	10.6	10.1	9.9	9.3
1992	60.5	31.8	22.9	18.7	15.7	13.3	11.4	10.2	9.7	916	8.9
1993	58.5	30.8	22.2	18.1	15.3	12.9	11.1	9.9	9.4	9.3	8.7
1994	56.9	30.0	21.7	17.7	14.9	12.6	10.8	9.7	9.2	9.1	8.5
1995	56.1	29.6	21.4	17.5	14.7	12.4	10.7	9.6	9.1	9.0	8.4

Urban areas with populations of 50,000 to 75,000 persons.

Table III-B5

Light Duty Gasoline Emission Factors

Year	Speed 5	10	15	20	25	30	35	40	45	50	55
1978	222.4	111.3	75.9	59.7	49.5	41.8	35.9	32.0	29.8	28.7	27.1
1979	204.8	103.1	70.8	55.9	46.4	39.1	33.6	29.9	28.0	27.0	25.4
1980	185.0	93.4	64.5	51.2	42.6	35.8	30.7	27.4	25.6	24.9	23.4
1981	165.0	83.6	58.0	46.2	38.4	32.3	27.7	24.6	23.1	22.5	21.1
1982	147.7	75.2	52.4	41.9	34.9	29.3	25.1	22.4	21.0	20.5	19.2
1983	130.6	66.8	46.8	37.6	31.3	26.3	22.5	20.1	18.9	18.5	17.3
1984	113.8	58.4	41.2	33.2	27.7	23.3	19.9	17.8	16.8	16.4	15.4
1985	100.5	51.8	36.7	29.6	24.8	20.8	17.8	15.9	15.0	14.7	13.8
1986	89.2	46.2	32.8	26.6	22.2	18.7	16.0	14.3	13.5	13.3	12.4
1987	80.4	41.8	29.8	24.2	20.3	17.0	14.6	13.0	12.4	12.1	11.3
1988	73.4	38.2	27.4	22.2	18.6	15.7	13.4	12.0	11.4	11.2	10.4
1989	67.6	35.4	25.4	20.7	17.3	14.6	12.5	11.2	10.6	10.4	9.8
1990	63.8	33.4	24.0	19.6	16.4	13.8	11.9	10.6	10.1	9.9	9.3
1991	60.6	31.8	22.9	18.7	15.7	13.2	11.3	10.2	9.6	9.5	8.9
1992	58.0	30.5	22.0	18.0	15.1	12.7	10.9	9.8	9.3	9.2	8.5
1993	56.0	29.5	21.3	17.4	14.6	12.3	10.6	9.5	9.0	8.9	8.3
1994	54.5	28.7	20.8	17.0	14.3	12.1	10.4	9.3	8.8	8.7	8.1
1995	53.7	28.3	20.5	16.8	14.1	11.9	10.2	9.2	8.7	8.6	8.0

Urban areas with populations of 75,000 to 100,000 persons.

Table III-B6

Light Duty Gasoline Emission Factors

Year	Speed 5	10	15	20	25	30	35	40	45	50	55
1978	232.5	117.5	80.4	63.6	53.0	45.0	38.9	34.8	32.5	31.4	29.7
1979	215.3	109.2	75.2	59.7	49.8	42.2	36.5	32.6	30.6	29.6	29.7
1980	195.2	99.4	68.8	54.8	45.7	38.8	33.4	29.9	28.0	27.2	25.7
1981	174.7	89.2	62.0	49.4	41.3	35.0	30.2	37.0	25.4	24.6	23.2
1982	157.1	80.5	56.2	45.0	37.6	31.8	27.4	24.5	23.1	22.5	21.1
1983	139.6	71.8	50.4	40.4	33.8	28.6	24.7	22.1	20.8	20.3	19.1
1984	122.3	63.2	44.5	35.8	30.0	25.4	21.9	19.6	18.5	18.1	17.0
1985	108.7	56.3	39.8	32.1	26.9	22.8	19.7	17.6	16.6	16.3	15.3
1986	97.1	50.4	35.7	28.9	24.3	20.6	17.7	15.9	15.0	14.7	13.8
1987	88.0	45.9	32.6	26.4	22.2	18.8	16.2	14.6	13.8	13.5	12.7
1988	80.7	42.2	30.0	24.4	20.5	17.4	15.0	13.5	12.8	12.5	11.7
1989	74.9	39.2	28.0	22.7	19.1	16.2	14.0	12.6	11.9	11.7	11.0
1990	70.9	37.2	26.6	21.6	18.2	15.4	13.3	12.0	11.4	11.1	10.5
1991	67.6	25.5	25.4	20.6	17.4	14.8	12.8	11.5	10.9	10.7	10.0
1992	65.0	24.3	24.4	19.9	16.8	14.3	12.3	11.1	10.5	10.3	9.7
1993	62.9	33.1	23.7	19.3	16.3	13.9	12.0	10.8	10.2	10.0	9.4
1994	61.3	32.3	23.2	18.9	16.0	13.6	11.7	10.6	10.0	9.8	9.2
1995	60.5	31.9	22.8	18.6	15.8	13.4	11.6	10.4	9.9	9.7	9.1

Urban areas with populations of 100,000 to 250,000 persons.

Table III-B7

Light Duty Gasoline Emission Factors

Year	Speed 5	10	15	20	25	30	35	40	45	50	55
1978	205.2	103.2	70.6	55.8	46.3	39.2	33.7	30.1	28.1	27.1	25.6
1979	187.4	94.8	65.4	51.9	43.2	36.5	31.4	28.0	26.2	25.4	23.9
1980	165.7	84.2	58.4	46.5	38.8	32.7	28.1	25.1	23.6	22.9	21.5
1981	143.9	73.4	51.1	40.9	24.1	28.7	24.7	22.0	20.7	20.2	18.9
1982	125.4	64.2	45.0	36.2	30.1	25.4	21.8	19.5	18.4	17.9	16.8
1983	107.6	55.4	39.1	31.5	26.4	22.2	19.1	17.1	16.1	15.8	14.8
1984	91.5	47.4	33.6	27.2	22.8	19.2	16.5	14.8	14.0	13.7	12.8
1985	79.4	41.3	29.4	23.8	20.0	16.9	14.5	13.0	12.3	12.1	11.3
1986	70.0	36.6	26.1	21.2	17.8	15.1	13.0	11.6	11.0	10.8	10.1
1987	62.8	32.9	23.5	19.2	16.1	13.6	11.8	10.6	10.0	9.8	9.2
1988	57.5	30.2	21.6	17.6	14.8	12.6	10.8	9.8	9.2	9.1	8.5
1989	53.7	28.2	20.2	16.5	13.9	11.8	10.2	9.2	8.7	8.5	8.0
1990	51.3	27.0	19.4	15.8	13.3	11.3	9.8	8.8	8.3	8.2	7.7
1991	49.5	26.1	18.7	15.2	12.8	10.9	9.4	8.5	8.1	7.9	7.4
1992	48.1	25.4	18.2	14.8	12.5	10.6	9.2	8.3	7.9	7.7	7.2
1993	47.2	24.9	17.9	14.6	12.3	10.5	9.0	8.2	7.7	7.6	7.1
1994	36.8	24.7	17.7	14.4	12.2	10.4	9.0	8.1	7.7	7.5	7.1
1995	46.5	24.6	17.6	14.4	12.1	10.3	8.9	8.0	7.6	7.5	7.0

City of Chicago and Cook County.

THE GENERAL APPROACH

This assessment of noise levels in the Cahokia Canal District is based on "Guidelines for Preparing Environmental Impact Statements on Noise" prepared under the auspices of the National Academy of Sciences. The analysis format followed specifically in this paper is displayed in Table IV-1.[1] As shown in this table, all general audible noises are examined in terms of three criteria: 1) potential for loss of hearing, 2) the health and welfare effects on people when day-night average sound levels (L_{dn}) exceed fifty-five decibels (dB(A)), and 3) there is the potential of environmental degradation/improvement on people and/or animals when the day-night average noise levels exceed fifty-five decibels. As indicated in Table IV-1 under the "Assessment Methodology Used" column, the sound levels weighted population (LWP) and noise impact index (NII) as well as narrative will be used to assess the effects of existing noise and added noise caused by Corps of Engineers construction activity. If day-night average noise levels exceed seventy-five decibels a population weighted loss of hearing (PLH) index will be utilized also. It should be mentioned, in addition, that any persistent exposure to noise levels above seventy-five day-night average levels (DNL) has the potential for severe health effects. As such, seventy-five DNL is an important reference value in describing impacts from noise on the population that will be exposed to such noise levels.

Table IV-1

Summary of Preparation of a Noise Impact Analysis

Type of Environment	Type of Criteria	Recommended Noise Measure	Assessment Methodology Used
General Audible Noises	Potential for Loss of Hearing	Day-Night Average Sound Level	Population Weighted Loss of Hearing (PLH)
(including low-level impulse noise)	Health & Welfare Effects on People [L_{dn} 55]	a. Day-Night Average Sound b. Word Description	a. Sound Level Weighted Population (LWP) and Noise Impact Index (NII) b. Description of the Effects
	Environmental Degradation/ Improvement on People and Animals [L_{dn} 55]		

Source: The National Research Council, Guidelines for Preparing Environmental Impact Statements on Noise, Prepared by Committee on Hearing, Bioacoustics and Biomechanics, National Academy of Sciences, Washington D.C., 1977, p. I-7.

DESCRIPTION OF POPULATION CHARACTERISTICS WITHIN THE CAHOKIA CANAL DISTRICT AND AREAS OF PROBABLE CONSTRUCTION ACTIVITY

The area of coverage for the purpose of noise assessment in the Cahokia Canal District is shown in Figure IV-1.* It is apparent from a glance at Figure IV-1 that only the American Bottoms (the Mississippi River Floodplain) portion of the Cahokia Canal District is considered in this phase of environmental assessment. The areas of probable construction activity are limited to the American Bottoms portion and are displayed by the zipatone patterns in Figure IV-1.

Most of the Cahokia Canal District that is situated in the American Bottoms is rural farm land. A substantial portion of the area is rural non-farm and the only urban area clearly within the American Bottoms portion of the Cahokia Canal District is the Granite City-Madison-Venice complex. Some of the demographic characteristics in the floodplain portion of the Cahokia Canal District are displayed in Table IV-2. From Table IV-2 it can be summarized that approximately seventy percent of the area in question is rural with a population density of eighty-six persons per square kilometer. This figure includes a number of unincorporated villages near the Granite City urban complex and the fringes of Collinsville and biases the actual rural population density. The true rural portions of the area in question have approximate rural densities of twenty to thirty persons per square kilometer rather than eighty to ninety persons per square kilometer, especially so in the east-central and north-

* All figures referred to are located in Volume 6 of 6 of this Environmental Inventory Report.

Table IV-2

Some Demographic Characteristics of the
Cahokia Canal District in the American Bottoms

Area	Population	Land Area		Population Density	
Rural	14,066	163.48 km^2	65.39 mi^2	86.04/km^2	215.10/$mile^2$
Urban	63,884	72.52 km^2	29.01 mi^2	880.92/km^2	2202.14/$mile^2$
Total	77,950	263.00 km^2	94.40 mi^2	330.30/km^2	825.74/$mile^2$

Source: Calculations by author from 1970 Census of Population.

eastern sectors. The urbanized portions of the area account for the remaining thirty percent of the area and have a population density mean value of 881 people per square kilometer or 2,202 people per square mile. For the most part, the area is characterized by low population densities except in the urban areas and in association with strip developments along some of the major highways.

SOURCES OF SOUND

The major sources of sound within the Cahokia Canal District at the present time are those associated with highway traffic. The highway pattern that exists within the Cahokia Canal District is displayed in Figure IV-1. The major interstate, the federal and state highways, focus on St. Louis so that the major flow of traffic is east-west. A few of the north-south federal highways have high peak hour traffic flow volumes, however, notably Highway 157 which follows the bluff line and gives access to Southern Illinois University and Edwardsville from points located to the south. Because Interstates 270 and 55/70 which traverse the area carry so many diesel powered, eighteen axle, heavy trucks, the highest continuous noise levels are associated with them. St. Louis is among the top five commercial truck centers in the United States and as such all interstates in the area carry a high proportion and volume of interstate truck traffic. Throughout many portions of the American Bottoms, however, vegetation is lush consisting of tall grass type growth or tree cover and consequently has the effect of muffling a substantial portion of all motor-vehicle related sounds.

The other major source of continuous noise in the American Bottoms portion of the Cahokia Canal District is associated with the Granite City iron and steel industrial complex. Sound levels exceed seventy-five decibels within certain portions of that complex, but are limited to the complex itself and do not affect the near environs of Granite City, much less the rural areas to the east where Corps of Engineers construction activity will take place.

Other major sources of noise which are not continuous are those associated with construction activity. These activities are ubiquitous, but are classified as either short-term or long-term temporary noise sources depending on whether they extend beyond six months.[2] There are no airports, quarries, mines, or other large industrial complexes such as Granite City Steel which would be classified as major point sources of continuous noise levels.

ANALYSIS OF THE EXISTING NOISE ENVIRONMENT

Because motor vehicles are the major source of continuous noise throughout most urban and all rural sections of the Cahokia Canal District, the NCHRP-174 model is used to project noise levels throughout most of the area in question. The NCHRP-174 noise prediction model employed in this report is based on a computer program utilized by the Federal Highway Administration (FHWA) and is contained in the National Cooperative Highway Research Program Report 174 (NCHRP-174). This noise prediction model has been sanctioned since 1972 and is influenced by the percentages of three types of vehicles.[3] These types are automobiles (A), trucks with two axles and six tires (MT), and trucks with more than two axles and six tires (HT).

In the Granite City-Madison-Venice urban complex, noise levels based on population densities are used in lieu of the NCHRP-174 model due to the complexities of this area. The population density model for predicting noise levels is described in the "Guidelines for Preparing Environmental Impact Statements on Noise" document previously mentioned in this report.[4]

The traffic flow for the major highways in the Cahokia Canal District is shown in Table IV-3. The traffic flow on Interstate 55/70 and Interstate 270 is clearly the heaviest and the daily flow in the case of both highways is nearly identical. The county highways, as can be seen in Table IV-1, have the lightest volumes of traffic.

The manner in which the traffic flow varies by time of day for each highway is presented in Table IV-4. Traffic volume on the interstates is somewhat more evenly distributed throughout the day-night interval, but the peak hours of traffic on all the area highways are the hours 1400 to 1800. Equally apparent is the fact that the lightest traffic volume on all area highways occurs in the early morning hours 0200 to 0600.

The noise levels predicted by the NCHRP-174 model are strongly affected by the mix of cars, medium and heavy trucks. The model is very sensitive to increasing numbers of heavy trucks and it is interesting to note from Table IV-5 that the time interval 0200 to 0600 hours is the time block which contains the highest proportion of heavy trucks, especially on the interstate highways. This fact, as will be seen in subsequent pages of this report, causes the inter-

Table IV-3

Traffic Flow as Situated in the American Bottoms of the Cahokia Canal District

Highway	Average Daily Number of Motor Vehicles (1977)
Interstate 55/70	25,800
Interstate 270	25,200
Illinois Highway 162	4,000-5,000
Illinois Highway 111	13,200
County Highway 35	1,760
County Highway 772	6,100
Illinois Highway 3	12,200
Illinois Highway 203	12,600
Illinois Highway 157	14,700

Source: Planning Division, Illinois Department of Highways, Belleville, Illinois, 1977.

Table IV-4

Traffic Flow in Percent as Broken Down by Four Hour Blocks

Highway	Average Percent of Daily Traffic Flow Broken Down in Four Hour Blocks					
	0200-0600	0600-1000	1000-1400	1400-1800	1800-2200	2200-0200
Interstate 55/70	5	23	21	25	16	10
Interstate 270	5	19	20	28	18	10
Highway 162	2	25	22	30	14	3
Highway 111	3	26	21	30	14	6
Highway 35	2	27	23	30	14	4
Highway 772	2	30	19	31	14	4
Highway 203	3	28	21	30	14	4
Highway 3	3	29	20	31	13	4
Highway 157	3	26	22	29	15	5

Source: Planning Division, Illinois Department of Highways, Belleville, Illinois, 1977.

Table IV-5

Existing Traffic Mix by Categories of Time on
FA Urban Systems for Use in Environmental Computer Programs

	Interstate			Primary FA			Secondary FA		
	Autos	Medium Trucks	Heavy Trucks	Autos	Medium Trucks	Heavy Trucks	Autos	Medium Trucks	Heavy Trucks
0200-0600	53%	4%	43%	79%	4%	17%	85%	4%	11%
0600-1000	88%	4%	8%	91%	4%	5%	91%	5%	4%
1000-1400	86%	5%	9%	93%	3%	4%	94%	3%	3%
1400-1800	92%	3%	5%	95%	2%	3%	95%	3%	3%
1800-2200	90%	2%	8%	97%	1%	2%	98%	1%	1%
2200-0200	82%	2%	16%	93%	2%	6%	98%	1%	1%
24 Hour Average	83%	4%	13%	92%	3%	5%	95%	2%	3%

Source: Federal Highway Administration Technical Advisory, T 5040.1, February 16, 1978, Attachment 1.

states to emit sound levels almost as intense and in some cases, more intense than in the 1400 to 1800 hour interval when there is a much greater volume, but a lower percentage (and number) of heavy trucks.

The day-night noise levels (DNL) generated by all of the area highways are shown in Table IV-6 as distance increases from fifteen meters to two and five-tenths kilometers. The NCHRP-174 noise prediction model projects sound levels in decibels rather than DNL and the original decibel levels as they vary with distance are shown in Tables IV-A1 through IV-A9 in the Appendix.[5]

The NCHRP-174 model in Cahokia Canal District has been programmed to take into effect the attenuation exerted by vegetation (tall grass cover or tree cover) from twenty-five meters distance and beyond. As can be seen from Table IV-6, both interstates produce noise levels well above seventy-five DNL at twenty-five meters distance. At a distance of one hundred meters, however, noise levels from the interstate as well as all highways are well below seventy DNL. At one kilometer distance, noise levels are well below fifty-five DNL for all highways. As pointed out earlier in this report, health and welfare effects on the resident population are not a problem below fifty-five DNL.

A perusal of Table IV-6 reveals that the area experiencing fifty-five DNL to seventy-five DNL is limited to an area of approximately 200 meters either side of all the highways in the Cahokia Canal District except for the interstates and Highways 157 and 111. In the case of Highways 157 and 111, noise levels above fifty-five DNL extend to 300 meters either side of the highways. Only in the

Table IV-6

Day-Night Sound Levels (DNL) as it Varies
With Distance From Area Highways

Distance	Int 55/70	Int 270	Hwy 157	Hwy 111	Hwy 203	Hwy 3	Hwy 162	Hwy 35	Hwy 772
15 meters	80.57	80.73	74.28	73.04	72.64	71.31	65.69	65.98	64.39
25 meters	77.24	77.40	72.06	69.71	70.42	67.99	62.36	62.65	61.06
100 meters	68.21	68.37	63.06	60.68	59.08	58.96	53.33	53.62	52.03
200 meters	63.69	63.85	58.50	56.16	54.61	54.44	48.81	49.10	47.51
300 meters	60.99	61.15	55.80	53.46	51.91	51.74	46.11	46.40	44.81
400 meters	59.18	59.34	53.99	51.65	50.01	49.92	44.30	44.59	42.99
500 meters	57.73	57.89	52.59	50.20	48.61	48.57	42.85	43.09	41.50
750 meters	55.13	55.29	49.99	48.43	46.01	45.97	41.08	41.49	38.90
1,000 meters	53.23	53.39	48.07	45.69	44.11	44.07	38.34	39.59	37.00
1,250 meters	51.73	51.89	47.09	45.71	42.61	42.57	37.35	38.08	35.60
1,500 meters	50.53	50.67	45.47	43.92	41.41	41.37	36.56	37.97	---
1,750 meters	49.59	49.77	44.89	42.47	40.51	40.47	35.14	36.99	---
2,000 meters	48.60	48.87	43.56	41.17	39.59	39.55	---	35.08	---
2,250 meters	47.85	48.07	42.76	40.37	38.79	38.75	---	---	---
2,500 meters	47.16	47.47	42.06	39.67	38.09	38.05	---	---	---

Source: Calculations by author based on data provided by Planning Division, Illinois Department of Transportation, Belleville, Illinois.

case of the interstates do noise levels exceeding fifty-five DNL extend for more than one-half kilometer. It should be noted also that sound levels of more than seventy-five DNL occur in association with the interstate, but only to an approximate distance of thirty-six meters either side of the highway.

The total area of the American Bottoms portion of the Cahokia Canal Distirct experiencing noise levels in excess of fifty-five DNL is shown in Table IV-7. About fifty-seven square kilometers of the area experience DNL of more than fifty-five decibels. More than half of that area is affected by noise levels associated with Interstates 55/70 and 270. The area that is affected by noise levels of more than fifty-five DNL is actually only fifty-two square kilometers (km^2) because of the fact that five and two-tenths square kilometers is actual highway surface or highway right-of-way. In Table IV-8 the total amount of land area affected by sound of more than seventy-five DNL is depicted. As noted at the bottom of Table IV-8 the one and four-tenths square kilometers where sound exceeds seventy-five DNL is associated with Interstates 270 and 55/70 and is confined within the limits of the interstate right-of-way.

The breakdown of rural areas within the Cahokia Canal District by DNL categories of five decibels is displayed in Table IV-9 for noise levels exceeding fifty-five decibels, but less than seventy-five decibels. These rural areas, because of highway-generated noise (principally from the interstates), experience noise levels which are more typical or urban areas, rather than open rural farm and non-

Table IV-7

Total Area in the Cahokia Canal District (American Bottom's Portion) in Which Noise Levels Exceed 55 DNL

Highway	Distance in Kilometers	Distance in Meters	Area in Square Kilometers
Int 55/70	8.7	800	13.9
Int 270	11.0	800	17.6
Hwy 157	8.3	350	5.8
Hwy 111	16.9	250	8.4
Hwy 203	11.2	200	4.5
Hwy 3	9.1	200	3.6
Hwy 162	6.2	100	1.2
Hwy 35	7.8	100	1.6
Hwy 772	2.9	100	.6
	Total . . 82.1		Total . . 57.2*

*Because 5.2 square kilometers of the 57.2 square kilometers is actual highway or its right-of-way; the corrected figure is 52.7 square kilometers (57.2 - 5.2).

Source: Calculations by author based on data provided by Planning Division, Illinois Department of Transportation, Belleville, Illinois.

Table IV-8

Total Area in the Cahokia Canal District in Which Noise Levels Exceed 75 DNL

Highway	Distance in Kilometers	Distance in Meters	Area in Square Kilometers
Int 55/70	8.7	36	0.6
Int 270	11.0	36	0.8
Hwy 157	8.3	--	---
Hwy 111	16.9	--	---
Hwy 203	11.2	--	---
Hwy 3	9.1	--	---
Hwy 162	6.2	--	---
Hwy 35	7.8	--	---
Hwy 772	2.9	--	---
	Total . . 82.1		Total . . 1.4*

*The total of 1.4 square kilometers is academic because nearly all of it is within interstate right-of-way.

Source: Calculation by author based on data provided by Planning Division, Illinois Department of Transportation, Belleville, Illinois.

Table IV-9

Breakdown of Rural Portions of Cahokia Canal
in Square Kilometers by DNL Categories and by Highways

Highway	Day-Night Noise Level Categories				
	70-75	65-70	60-65	55-60	< 55
Int 55/70	---	1.0	3.5	7.8	12.3
Int 270	---	1.2	4.4	9.9	15.6
Hwy 157	0.4	.7	2.7	1.9	5.7
Hwy 111	0.3	1.2	2.0	4.3	7.9
Hwy 203	0.2	.5	.9	2.6	4.2
Hwy 3	---	.4	.5	2.5	3.4
Hwy 162	---	.1	.4	.6	1.1
Hwy 35	---	.1	.4	.7	1.2
Hwy 772	---	---	.2	.4	0.6
Totals	0.9	5.4	15.0	30.7	52.0

Source: Calculations by author based on data provided by Planning Division, Illinois Department of Transportation, Belleville, Illinois.

farm land. A basis for comparison is provided by the data and narrative in Table IV-10. It should be repeated at this point that the fifty-two square kilometer area which is exposed to DNL values of more than fifty-five decibels is of a linear nature which very closely parallels the highways, and more than half of the fifty-two square kilometer area is associated with narrow paralled strips along Interstates 55/70 and 270. Locations more than 800 meters distant from the interstates and 300 meters from the rest of the highways experience sound levels that are typical of rural and suburban areas.

Another basis for comparison is provided by Table IV-11 which depicts design noise levels and land use relationships as determined by the FHWA. A comparison of Table IV-9 and IV-11 shows that all of the rural area except for twenty-one and three tenths square kilometers is suitable for open space land use as described for land use category A in Table IV-11. All but nine tenths square kilometer is suitable for the land uses described in category B of table IV-11.

Additional analysis is afforded by the data shown in Tables IV-12 and IV-13. These tables depict the sound levels produced by area highways in twenty-four hour average decibel values instead of noise levels expressed in DNL values as in Tables IV-6 through IV-10. The data displayed in Table IV-12 is based on predicted noise levels as calculated by the NCHRP-174 model assuming either natural or agricultural tall grass vegetation or tree cover throughout the extent of the rural portions of the Cahokia Canal District. As mentioned earlier, most of the Cahokia Canal area is characterized by lush vegetation and a perusal of Table IV-12 reveals that only sixteen square kilometers of

Table IV-10

Typical Values Of Yearly Day-Night Average Sound Levels For Residential Neighborhoods Where There Is No Well Defined Sources Of Noise Other Than Usual Transportation Noise

Description	Population Density (Persons per Square Mile)	L_{dn} - dB
Rural (underdeveloped)	20	35
Rural (partly developed)	60	40
Quiet Suburban	200	45
Normal Suburban	600	50
Urban	2,000	55
Noisy Urban	6,000	60
Very Noisy Urban	20,000	65

Source: Committee on Hearing, Bioacoustics, and Biomechanics, Guidelines for Preparing Environmental Impact Statements on Noise, National Academy of Sciences, Washington, D.C., 1977, p. IV-7.

Table IV-11

Design Noise Level/Land Use Relationships

Land Use Category	Design Noise Level - L_{10}	Description of Land Use Category
A	60 dB(A) (Exterior)	Tracts of lands in which serenity and quiet are of extraordinary significance and serve an important public need, and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose. Such areas could include amphitheaters, particular parks or portions of parks, or open spaces which are dedicated or recognized by appropriate local officials for activities requiring special qualities of serenity and quiet.
B	70 dB(A) (Exterior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, picnic areas, recreation areas, playgrounds, active sports areas, and parks.
C	75 dB(A) (Exterior)	Developed lands, properties or activities not included in categories A and B above.
D	--	For requirements on undeveloped lands see paragraphs 5.a(5) and (6) of PPM 90-2.
E	55 dB(A) (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals and auditoriums.

Source: Federal Highway Administration, Noise Standards and Procedures, (National Technical Information Service, 1972), p. 177.

Table IV-12

Breakdown of Rural Portions of Cahokia Canal
in Square Kilometers by dB(A) Categories and by Highways*

			dB(A) Categories		
Highway	70-75	65-70	60-65	55-60	< 55
Int 55/70	---	---	1.044	2.260	3.304
Int 270	---	---	1.320	2.857	4.177
Hwy 157	---	0.498	0.415	0.581	1.494
Hwy 111	---	0.845	0.845	1.183	2.873
Hwy 203	---	0.448	0.560	0.784	1.792
Hwy 3	---	0.273	0.455	0.637	1.365
Hwy 162	---	---	---	0.372	0.372
Hwy 35	---	---	---	0.468	0.468
Hwy 772	---	---	---	0.174	0.174
Totals	---	2.064	4.639	9.316	16.019

*Assuming attenuation rates based on tall grass or tree cover type vegetation

Source: Calculations by author based on data provided by Planning Division, Illinois Department of Transportation, Belleville, Illinois.

Table IV-13

Breakdown of Rural Portions of the Cahokia Canal District in Square Kilometers by 24 Hour Average dB(A) Categories and Highways*

	dB(A) Categories				
Highway	70-75	65-70	60-65	55-60	< 55
Int 55/70	---	1.131	4.698	16.530	22.359
Int 270	---	1.431	5.940	20.900	28.271
Hwy 157	---	.332	1.245	1.826	3.403
Hwy 111	---	.507	2.028	5.577	8.112
Hwy 203	---	.336	.728	3.136	4.704
Hwy 3	---	---	---	2.457	3.185
Hwy 162	---	---	---	0.430	0.434
Hwy 35	---	---	---	0.546	0.546
Hwy 772	---	---	---	0.174	0.174
Totals	---	3.437	15.871	51.580	71.188

*All of the area and some of the area in the 70-75 dB(A) category and the 65-70 dB(A) category, respectively, are not shown because they occur within the interstate highways' right-of- ways.

Source: Calculations by author based on data provided by Planning Division, Illinois Department of Transportation, Belleville, Illinois.

the entire area experience sound levels of more than fifty-five decibels on an average twenty-four hour basis.

Substantial portions of the Cahokia Canal District are agricultural, and as a consequence, many acres lie fallow during the dormant or winter season. These areas, in the context of noise modelling, are bare ground surfaces which do not attenuate sound with increasing distance as rapidly as tall grass covered or tree covered surfaces. This fact is apparent in an examination of Table IV-13 which shows that during the winter season, a much larger area is exposed to sound levels in excess of fifty-five decibel values on an average twenty-four hour basis. It should be pointed out that the square kilometer land area values in each decibel category of Table IV-13 are not to be interpreted literally. Table IV-13 was constructed on the basis that all of the rural area of the Cahokia Canal District is agricultural land when in fact only seventy percent of these areas are agricultural. Much of the remaining thirty percent is poorly drained marsh or swamp land that is characterized by natural tall grass or tree cover all year. Taking this fact into consideration, plus the fact that the seventy percent agricultural land attenuates sounds as depicted in Table IV-12 during the growing season, the amount of land on an annual basis throughout the extent of the rural areas of the Cahokia Canal District exposed to average twenty-four hour sound levels of more than fifty-five decibels is much less than the seventy-two square kilometers shown in Table IV-13. Instead, the amount of land exposed to average twenty-four hour sound levels exceeding fifty-five decibels on a yearly basis is approximately thirty-five square kilometers. Specific information as to the rate of the attenuation of sound in terms of twenty-four hour average decibel values (vegetative and non-vegetative) is shown in the Appendix in Tables IV-A10 and IV-A11.

The distribution of existing noise levels in the Cahokia Canal District has been examined in some detail, hopefully, at this point. The impact of noise as it is distributed throughout the Cahokia Canal Area on the population, however, has not been examined, except in a very general approach as pertains to the discussion associated with Table IV-11.

Two types of numerical descriptors for this purpose are suggested by the National Academy of Sciences.[6] The first descriptor is the numerical change in sound level weighted populations before and after the action. The change can be expressed as the actual sound level weighted population difference before and after or as a percentage change. The second descriptor, the noise impact index (NII), utilizes the sound level weighted population value to express population impact before and after the action in question, also. Both of these numerical descriptors have been calculated for noise levels as they exist in 1979 in Table IV-14. If DNL of seventy-five decibels or more exist, then another numerical descriptor may be used to describe the potential and degree of hearing loss to the exposed population. This descriptor is the population weighted loss of hearing index (PLH).

As can be seen from Table IV-14, the sound level weighted population descriptor is 45.721. DNL value of seventy-five decibels has a benchmark or reference value of one as seen in Table IV-15

Table IV-14

Calculation of Level Weighted Population Computation in the Urban and Rural Areas of Cahokia Canal

L_{dn} dB(A) Category	Cumulative Population (hundreds)	Incremental Population (hundreds)	Weighting Function	Level Weighted Population (hundreds)
> 75	---	---	1.214	---
70-75	---	---	.832	---
65-70	0.53	0.53	.538	0.285
60-65	3.20	2.67	.324	0.865
55-60	51.03	47.83	.180	8.609
50-55	117.31	66.28	.093	6.164
< 50	766.96	662.19	.045	29.798
Totals		779.80		45.721

$$NII = \frac{45.721}{779.500} = 0.059$$

Source: Calculations by author using FHWA Highway Noise Model and Guidelines for Preparing Environmental Impact Statements on Noise, p. VII-10.

Table IV-15

Sound Level Weighting Function for Overall Impact Analysis

L_{dn} - dB(A)*	$W(L_{dn})$	$\frac{W(L_{dn}) + W(L_{dn} + 5)}{2}$
35	0.006	0.010
40	0.013	0.021
45	0.029	0.245
50	0.061	0.093
55	0.124	0.180
60	0.235	0.324
65	0.412	0.538
70	0.664	0.832
75	1.000	1.214
80	1.428	1.697
85	1.966	2.307
90	2.647	

*This column is included for convenience for finding the weighting of certain 5 dB(A) increments.

Source: National Academy of Science, Guidelines for Preparing EIS on Noise, 1977, p. VII-6.

and DNL values as they decrease to values less than seventy-five decibels have correspondingly lower fractional values of less than one. Consequently, the 45.721 sound level weighted population value can be interpreted as saying the day-night noise levels (DNL) which are generated throughout Cahokia Canal, if concentrated, would impact as if 4,572 people out of a total population of 97,950 experienced an accumulation of noise levels near seventy-five decibels and the remaining 721,794 would not experience any noise level. This value by itself is not as germane as the change in the sound level weighted population value before and after the action planned has been completed as the significant value.

The noise impact index (NII) in Table IV-14 equals 0.059 in this sound level weighted population divided by the total population of the Cahokia Canal District (766,966). As in the case of the sound level weighted population value, the NII value in itself is not as meaningful as the change the NII will show after the action planned is completed.

The values in Table IV-14 include urban noise levels for the Granite City-Venice-Madison urban area. The DNL values for this urban area may be estimated from the values displayed in Table IV-10 of this report and based on the model $L_{dn} = 10 \log Q + 22dB$, where Q is the population density in people per square mile.[7]

ANALYSIS OF THE FUTURE NOISE ENVIRONMENT DURING AND AFTER THE PLANNED CONSTRUCTION ACTIVITY IN THE CAHOKIA CANAL DISTRICT

Several complications prevent precise determination of the future noise environment in the Cahokia Canal District during Corps of Engineer construction activity. As mentioned previously there will be many probable areas of construction, but relatively few areas of actual construction. Therefore, the approximate number of construction sites is unknown at this time, much less the precise number. When the construction will take place is also unknown, but will take place presumably between 1982 and 1984. In addition, the exact mix and number of bulldozers, cranes, water pumps, trucks, loaders, and graders is not known and only an estimate of the mix and number of construction vehicles and units is possible.[8]

The first unknown (where construction will take place) is the most difficult condition to estimate and in this section, the construction will be assumed to be almost exclusively in the rural areas well to the east of Granite City. The only exception to this restriction will be planned construction along Dobrey Slough along the eastern boundary of Granite City. The second unknown is of some significance in the context of how much population will be affected when construction does begin. The best estimate for beginning construction is 1982 and duration of construction is expected to be around one year for all construction sites. Population in the rural sections of the Cahokia Canal District is expected to change very little in the next three years and for this reason, 1979 population estimates will be used in calculating sound level weighted population values and the noise impact index during the period of construction.

The third unknown (number and mix of construction machinery units) is the least critical, relatively speaking, and was estimated by Mr. John Dierker (St. Louis District, U.S. Army Corps of Engineers) to consist of four configurations. The four configurations are shown in Tables IV-16 through IV-19. The horsepower ratings and decibel sound levels (at the operator locations) are displayed in these tables.[9]

The change in the noise environment in the Cahokia Canal Area is expected to persist only as long as construction activity lasts. Because the construction activity is expected to last longer than six months but less than ten years, the project is classified as a long term temporary project which will require the calculation of yearly day-night noise levels (YDNL).[10]

The calculation of noise levels produced by the four configurations shown in Tables IV-16 through IV-19 is different from the calculations of highway noise levels with increasing distance as predicted by the FHWA NCHRP-174 model. Highway sounds attenuate with increasing distance at a lesser rate than point sources of noise, which will be the case for the Corps of Engineers' construction activity when it takes place.[11] The rate of attenuation from the point sources of sound, such as the possible construction sites, is displayed in Tables IV-20 through IV-22. In these tables, no vegetative cover is assumed which would decrease the noise intensity fifty percent more than shown in Tables IV-20 through IV-22 and as such the values shown in these tables are considered to be conservative.[12]

Sound levels in decibel values are depicted with increasing distance in Table IV-20 for each of the four construction configuruations shown in Tables IV-16 through IV-19. As can be seen in

Table IV-16

#1 Construction Configurations
Channel Levee Section With "No-Burrow"

	HP	dB(A)
1 D-8 Bulldozer	300	102-106
1 D-6 Bulldozer	145	95-96
1 DL Mod 3900 W Crane	285	88-89
1 Hydro-Seeder	---	80-82

Minimum Total . . 103.2 dB(A)

Maximum Total . . 106.65 dB(A)

Source: C.R. Bragdon, Noise Pollution, University of Pennsylvania Press, Philadelphia, 1970, p. 115.

Table IV-17

#2 Construction Configurations
Channel Levee Section With "Burrow"

	HP	dB(A)
1 D-8 Bulldozer	300	102-106
1 D-6 Bulldozer	145	95-96
1 (CAT) 983 Front End Loader	275	95-97
3-4 Euclid R-35 Off-Road Trucks	430	98
or		
5-6 Euclid R-22 Off-Road Trucks	220	95

Minimum Total . . 105.8

Maximum Total . . 107.8

Source: C.R. Bragdon, Noise Pollution, University of Pennsylvania Press, Philadelphia, 1970, p. 115.

Table IV-18

#3 Construction Configurations
Channel Levee Section With "Spoil"

	HP	dB(A)
3-4 Euclid R-35 Off-Road Trucks	430	98
5-6 Euclid R-22 Off-Road Trucks	220	95
1 D-8 Bulldozer	300	102-106
1 D-6 Bulldozer	145	95-96
1 DL Mod 3900 W Crane	285	88-89
	Minimum Total . .	105.3
	Maximum Total . .	107.7

Source: C.R. Bragdon, Noise Pollution, University of Pennsylvania Press, Philadelphia, 1970, p. 115.

Table IV-19

#4 Bridge

2 Jack Hammers	110 or 111
1 Pile Driver	100 or 103
1 Crane	89
2 Vibrators	103 or 106
2 Air Compressors	105 or 108
Minimum Total . .	112.5
Maximum Total . .	115.5

Source: C.R. Bragdon, Noise Pollution, University of Pennsylvania Press, Philadelphia, 1970, p. 115.

Table IV-20

Sound Levels dB(A) as Distance Varies From Construction Activity During an Eight Hour Shift in the Cahokia Canal Area

Distance	Construction Configuration			
	#1	#2	#3	#4
	Channel Levee Section With "No-Borrow"	Channel Levee Section With "Borrow"	Channel Levee Section With "Spoil"	Bridges
0 meters	103.2-106.6	105.8-107.8	105.3-107.7	106.2
15 meters	82.1-85.5	84.7-86.7	84.2-86.6	85.1
25 meters	78.1-81.1	80.7-82.7	80.2-82.6	81.1
100 meters	65.1-69.1	69.2-71.2	68.7-71.1	69.6
200 meters	59.6-63.0	63.2-65.2	62.7-65.1	63.6
300 meters	56.1-59.5	59.7-61.7	59.2-61.6	60.1
400 meters	53.6-57.2	57.2-59.2	56.7-59.1	57.6
500 meters	51.6-55.2	55.2-57.2	54.7-57.1	55.6
750 meters	48.1-51.7	51.7-53.7	51.2-53.6	52.1
1,000 meters	45.6-49.2	49.2-51.6	48.7-51.1	49.6
1,250 meters	43.7-47.3	47.2-49.7	46.8-49.2	47.7
1,500 meters	42.1-45.7	45.7-48.1	45.2-47.8	46.1
1,750 meters	40.7-44.3	44.3-46.7	43.8-46.2	44.7
2,000 meters	39.6-43.2	43.2-45.6	42.7-45.1	43.6
2,250 meters	38.6-42.2	42.2-44.6	41.7-44.1	42.6
2,500 meters	37.6-41.2	41.2-43.6	40.7-43.1	41.0

Source: C.R. Bragdon, Noise Pollution, University of Pennsylvania Press, Philadelphia, 1970, p. 115.

Table IV-21

DNL for Cahokia Canal When Construction Activity Begins

Distance	Construction Configuration			
	#1	#2	#3	#4
	Channel Levee Section With "No-Borrow"	Channel Levee Section With "Borrow"	Channel Levee Section With "Spoil"	Bridge
0 meters	98.4-101.8	101.0-103.4	100.5-102.9	101.4
15 meters	77.3-80.7	80.5-82.3	79.4-81.8	80.5
25 meters	73.3-76.7	77.5-79.3	76.4-78.8	77.5
100 meters	61.8-65.2	66.0-67.8	64.0-67.3	66.0
200 meters	55.8-59.2	60.0-61.8	58.9-61.3	60.0
300 meters	52.3-55.7	56.5-58.3	55.4-57.8	56.5
400 meters	48.8-53.2	54.0-55.8	52.9-55.3	54.0
500 meters	47.8-51.2	52.0-53.8	50.9-53.3	52.0
750 meters	44.5-47.7	48.5-50.3	47.4-49.8	48.5
1,000 meters	41.8-45.2	46.0-47.8	44.9-47.3	46.0
1,250 meters	39.9-43.3	44.1-45.9	43.0-45.4	44.1
1,500 meters	38.3-41.7	42.5-44.3	41.4-44.1	42.5
1,750 meters	36.9-40.3	41.1-42.9	40.0-42.7	41.1
2,000 meters	35.8-38.2	40.0-42.8	38.9-41.6	40.0
2,250 meters	34.8-38.2	39.0-41.8	37.9-40.6	39.0
2,500 meters	33.8-37.2	38.0-40.8	36.0-39.6	38.0

Source: C.R. Bragdon, Noise Pollution University of Pennsylvania Press, Philadelphia, 1970, p. 115.

Table IV-22

YDNL for Cahokia Canal When Construction Activity Begins

Distance	Construction Configuration			
	#1	#2	#3	#4
	Channel Levee Section With "No-Borrow"	Channel Levee Section With "Borrow"	Channel Levee Section With "Spoil"	Bridge
0 meters	95.4-97.0	98.0-100.4	97.5-99.9	98.4
15 meters	74.3-75.9	76.9-79.3	76.4-78.8	77.3
25 meters	70.3-71.9	72.9-75.3	72.4-74.8	73.3
100 meters	59.8-60.4	61.4-63.8	60.9-63.3	61.8
200 meters	52.8-54.4	55.4-57.8	54.9-56.8	55.8
300 meters	49.3-50.9	51.9-54.3	51.4-53.8	52.3
400 meters	47.8-48.4	49.4-52.0	48.4-51.3	49.8
500 meters	44.8-46.4	47.4-50.0	46.9-49.3	47.8
750 meters	41.3-42.9	43.9-46.5	43.4-45.8	44.8
1,000 meters	38.8-40.4	41.4-44.0	40.9-43.3	41.8
1,250 meters	36.9-38.5	39.5-42.1	39.0-41.4	39.9
1,500 meters	35.3-36.9	37.9-40.5	36.4-39.8	38.3
1,750 meters	33.9-35.5	36.5-39.1	36.0-38.4	36.9
2,000 meters	32.8-34.4	35.4-38.0	34.9-37.3	35.8
2,250 meters	31.8-33.4	34.4-37.0	33.9-36.3	34.8
2,500 meters	30.8-32.4	33.4-36.0	32.9-35.3	33.8

Source: C.R. Bragdon, Noise Pollution, University of Pennsylvania Press, Philadelphia, 1970, p. 115.

Table IV-21 all maximum as well as minimum sound level values are well below fifty-five decibels at a distance of 750 meters as generated from any of the four construction activity configurations. The sound levels at zero distance are considerably louder than existing transportation noise levels from the interstates. At a distance of fifteen meters, they diminish considerably and by the time sound has been propagated at a distance of one hundred meters, sound levels are well below the reference level of seventy-five decibels which is used to gauge potential hearing loss of residential populations.

In Table IV-21 day-night noise levels (DNL) are shown in terms of decibels with increasing distance. The DNL are considerably less than the decibel levels shown in Table IV-20, because of the assumption of no construction activity between five p.m. and eight a.m.[13] The DNL values associated with the estimated construction activity are likewise less than the transportation DNL values estimated previously in this report. This, of course, is due to the fact that transportation produced sound levels continue on a twenty-four hour basis while those associated with Cahokia Canal Area construction activity will operate on an eight hour basis. A perusal of Table IV-21 reveals that at a distance of one hundred meters, DNL values are well below seventy decibels and below or equal to fifty-five decibels at a distance of 400 meters.

Because of inclement weather and other occurrances, the actual amount of construction is estimated to be only six months spread out over a full year duration.[14] This consideration led to the calculation shown in Table IV-22 which reveals yearly day-night noise levels (YDNL) that would result from the four different construction configurations. YDNL values at a distance of twenty-five meters are all less than seventy-five decibels and substantially less than fifty-five decibels at a distance of 300 meters. Both the DNL and YDNL values in Tables IV-21 and IV-22 are more germane in the assessment of potential harm placed upon the human (and animal) population of the Cahokia Canal Area than the decibel levels displayed in Table IV-20 as produced by Corps of Engineer construction activity.

The sound level weighted population and noise intensity index for the Cahokia Canal Area during construction activity is presented in Table IV-23. The calculations in this table assume construction at four different locations at any one time and as indicated by the footnote, construction near the eastern edge of Granite City is assumed. Another basis in the construction of this table is that no matter where construction may take place in the rural portion of this area, it will affect approximately the same number of people. Population is distributed fairly evenly throughout the rural portions where construction activity is likely. In addition, most of the probable construction activity will take place at substantial distances (more than 400 meters) from highways or non-farm rural residential clusters. Only in the case of possible construction in the Dobrey Slough area will construction activity take place within 400 meters distance of an urban or suburban area.

Table IV-23

Level Weighted Population in the Cahokia Canal Area With Corps of Engineer Construction Activity (1982)*

L_{dn} dB(A)	Cumulative Population (hundreds)	Incremental Population (hundreds)	Weighting Function	Level Weighted Population (hundreds)
> 75	---	---	1.214	---
70-75	0.41	0.41	0.832	.342
65-70	3.92	3.51	0.538	1.888
60-65	11.30	7.38	0.324	2.391
55-60	81.07	69.77	0.180	12.559
50-55	370.49	289.42	0.093	26.916
< 50	766.96	396.47	0.045	17.841
Totals		766.96		61.936

$$NII = \frac{61.936}{766.960} = 0.081$$

*Assuming construction along Dobrey Slough near the eastern edge of Granite City.

Source: Calculations by author according to Guidelines for Preparing EIS on Noise (National Academy of Science), p. VII-10.

As can be seen from Table IV-23, the sound level weighted population value is sixty-one and nine hundred thirty-six thousandths as compared to the forty-five and one hundred fifty-seven thousandths value in Table IV-14 for present noise levels. The absolute change in this numerical descriptor of population impact is an increase of sixteen and seven hundred sixty-six thousandths or a percentage increase of thirty-seven and one tenth. This temporary increase is not important in terms of potential loss of hearing due to construction activity. The NII of eighty-one thousandths calculated in Table IV-23 is an increase of twenty-two thousandths over the NII of fifty-nine thousandths calculated in Table IV-14 for existing noise levels. Again, the increase in noise levels expressed in terms of the NII is trivial and no significant potential for loss of hearing will occur in the case of the residential population. Because the project is temporary and DNL and YDNL values will be at or below fifty decibels at 500 meters distance and more during construction, no degradation of the overall environment is foreseen. All of the land uses described in Table IV-11 will be possible in the Cahokia Canal District during construction as well as after construction.

FOOTNOTES

[1]Committee on Hearing, Bioacoustics, and Biomechanics, Guidelines for Preparing EIS, National Academy of Sciences, Washington, D.C., 1977, p. I-7.

[2]*Op. Cit.*, p. I-8.

[3]U.S. Department of Transportation, Federal Highway Administration Technical Advisory, T 5040.1, February 16, 1978, p.3.

[4]Committee on Hearing, Bioacoustics, and Biomechanics, *Op. Cit.*, p. IV-7.

[5]The conversion from dB(A) sound levels to DNL is accomplished by:

$$L_{dn} = 10 \log_{10} \frac{1}{86400} \int_{0000}^{0700} 10^{[L_A(t)+10]/10} dt + \int_{0700}^{2200} 10^{L_A(t)/10} dt + \int_{2200}^{2400} 10^{[L_A(t)+10]/10} dt$$

where t is in seconds.

[6]*Ibid.*, p. VII-9.

[7]*Ibid.*, p. IV-6.

[8]Conversation with Mr. Owen Dutt and Mr. John Dierker of the Environmental Planning Section and Construction Design Section (respectively), St. Louis District, U.S. Army Corps of Engineers, March 19, 1979.

[9]See the 1977 St. Louis District Equipment Ownership and Operating Expense Schedule for the horsepower ratings and Noise Pollution Aspects of Barge, Railroad and Truck Transportation, p. 32 (prepared for Alton Lock and Dam Project, St. Louis District, U.S. Army Corps of Engineers, by Charles A. Thornton) for the dB(A) values.

[10]National Academy of Sciences, Guidelines for Preparing EIS on Noise, Washington, D.C., 1977, p. I-8.

[11]Isadore Rudnick, "Propagation of Sound in Open Air", Handbook of Noise Control (ed. Cyril M. Harris), McGraw-Hill Co., Inc., New York, 1957, pp. 3-1 to 3-17.

[12]D.E. Commins, B.A. Kubler, and A.G. Pierson, "Evaluation of Highway Noise Propagation Based Upon Energy Levels", Noise-Con 73 Proceedings, Washington, D.C., October 15-17, 1973, pp. 115-120.

[13]Measured dB(A) levels at night in the interior areas were around 35 dB(A), so 45 dB(A) was used as the night value in the computation of DNL.

[14]Conversation with Mr. John Dierker, Design Section, St. Louis District, U.S. Army Corps of Engineers, March 22, 1979.

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APPENDIX A

Table IV-A1

Sound Level Attenuation (dB(A)) as it Varies
With Distance From Interstate 55/70

Distance	Maximum (H)	Minimum (H)	Maximum (S)	Minimum (S)
15 meters	75.25	73.13	75.25	73.13
25 meters	72.78	70.91	71.92	69.80
100 meters	66.77	64.90	61.69	59.57
200 meters	63.77	61.65	57.22	55.10
300 meters	61.97	59.85	54.52	52.40
400 meters	60.77	58.65	52.62	50.50
500 meters	59.77	57.65	51.22	49.10
750 meters	57.97	55.83	48.62	46.50
1,000 meters	56.77	54.65	46.62	44.38
1,250 meters	55.77	53.65	45.22	43.10
1,500 meters	54.97	52.85	44.02	41.90
1,750 meters	54.37	52.25	43.12	41.00
2,000 meters	54.77	51.65	42.22	40.10
2,250 meters	53.27	51.15	41.14	39.02
2,500 meters	52.76	50.64	40.72	38.60

Table IV-A2

Sound Level Attenuation (dB(A)) as it Varies
With Distance from Interstate 270

Distance	Maximum (H)	Minimum (H)	Maximum (S)	Minimum (S)
15 meters	75.75	71.91	75.75	71.91
25 meters	73.55	69.79	72.52	68.58
100 meters	67.65	63.81	62.25	58.41
200 meters	64.65	60.81	57.75	53.91
300 meters	62.85	59.01	55.05	51.21
400 meters	61.65	57.81	53.15	49.31
500 meters	60.65	56.81	51.75	47.91
750 meters	58.85	55.01	49.15	45.41
1,000 meters	57.65	53.81	47.25	43.41
1,250 meters	55.85	52.01	45.75	41.91
1,500 meters	55.85	52.01	44.55	40.71
1,750 meters	55.25	51.41	43.65	39.81
2,000 meters	54.65	50.81	42.75	38.91
2,250 meters	54.15	50.31	41.95	38.11
2,500 meters	52.84	49.00	41.25	37.41

Table IV-A3

Sound Level Attenuation in dB(A) as it Varies With Distance from Highway 157

Distance	Maximum dB(A)	Minimum dB(A)
15 meters	71.32	65.41
25 meters	69.10	63.19
100 meters	57.76	51.85
200 meters	53.29	47.38
300 meters	50.59	44.68
400 meters	48.69	42.78
500 meters	47.29	41.38
750 meters	44.69	38.78
1,000 meters	42.79	36.88
1,250 meters	41.29	35.38
1,500 meters	40.09	34.18
1,750 meters	39.19	---
2,000 meters	38.29	---
2,250 meters	37.49	---
2,500 meters	36.77	---

Table IV-A4

Sound Level Attenuation in dB(A) as it Varies
With Distance from Highway 111

Distance	Maximum dB(A)	Minimum dB(A)
15 meters	71.03	65.13
25 meters	68.81	62.91
100 meters	57.47	51.57
200 meters	53.00	47.10
300 meters	50.30	44.40
400 meters	48.40	42.50
500 meters	47.00	41.10
750 meters	44.40	38.50
1,000 meters	42.50	36.60
1,250 meters	41.00	35.10
1,500 meters	39.80	---
1,750 meters	38.90	---
2,000 meters	38.00	---
2,250 meters	37.20	---
2,500 meters	36.50	---

Table IV-A5

Sound Level Attenuation in dB(A) as it Varies With Distance from Highway 203

Distance	Maximum dB(A)	Minimum dB(A)
15 meters	70.09	63.67
25 meters	67.87	61.45
100 meters	56.53	50.11
200 meters	52.06	45.64
300 meters	49.36	42.94
400 meters	47.46	41.04
500 meters	46.06	39.64
750 meters	43.46	37.04
1,000 meters	41.56	35.14
1,250 meters	40.06	---
1,500 meters	38.86	---
1,750 meters	37.96	---
2,000 meters	37.06	---
2,250 meters	36.26	---
2,500 meters	35.56	---

Table IV-A6

Sound Level Attenuation in dB(A) as it Varies With Distance from Highway 3

Distance	Maximum dB(A)	Minimum dB(A)
15 meters	70.01	62.87
25 meters	67.79	60.65
100 meters	56.45	49.31
200 meters	51.98	44.84
300 meters	49.28	42.14
400 meters	47.38	40.24
500 meters	45.98	38.84
750 meters	43.38	36.24
1,000 meters	41.48	---
1,250 meters	39.98	---
1,500 meters	38.78	---
1,750 meters	37.88	---
2,000 meters	36.98	---
2,250 meters	36.18	---
2,500 meters	35.48	---

Table IV-A7

Sound Level Attenuation in dB(A) as it Varies
With Distance from Highway 162

Distance	Maximum dB(A)	Minimum dB(A)
15 meters	65.28	56.29
25 meters	63.06	54.07
100 meters	51.72	42.73
200 meters	47.25	38.26
300 meters	44.55	35.56
400 meters	42.65	---
500 meters	41.25	---
750 meters	38.65	---
1,000 meters	36.75	---
1,250 meters	---	---
1,500 meters	---	---
1,750 meters	---	---
2,000 meters	---	---
2,250 meters	---	---
2,500 meters	---	---

Table IV-A8

Sound Level Attenuation in dB(A) as it Varies With Distance from County Highway 35

Distance	Maximum dB(A)	Minimum dB(A)
15 meters	67.75	59.47
25 meters	65.53	57.25
100 meters	54.19	45.91
200 meters	49.72	41.44
300 meters	47.02	38.74
400 meters	45.12	36.84
500 meters	43.72	35.44
750 meters	41.12	---
1,000 meters	39.22	---
1,250 meters	37.72	---
1,500 meters	36.52	---
1,750 meters	35.62	---

Table IV-A9

Sound Level Attenuation in dB(A) as it Varies
With Distance from County Highway 772

Distance	Maximum dB(A)	Minimum dB(A)
15 meters	62.34	54.41
25 meters	60.12	52.19
100 meters	48.78	40.85
200 meters	44.31	36.38
300 meters	41.61	---
400 meters	39.71	---
500 meters	38.31	---
750 meters	35.71	---
1,000 meters	---	---
1,250 meters	---	---
1,500 meters	---	---

Table IV-A10

Day-Night Sound Level (DNL) as it Varies With Distance
From Area Highways and Assuming Tall Grass and/or Tree Cover

Distance	Int 55/70	Int 270	Hwy 157	Hwy 111	Hwy 203	Hwy 3	Hwy 162	Hwy 35	Hwy 772
15 meters	74.57	74.43	68.28	67.04	66.64	65.31	59.31	59.98	58.39
25 meters	72.35	42.51	66.06	64.82	64.42	63.09	57.09	57.76	56.17
100 meters	61.01	61.17	54.72	53.48	53.08	51.75	45.75	46.42	44.83
200 meters	56.54	56.70	50.25	49.01	48.61	47.28	41.28	41.95	40.36
300 meters	53.84	54.00	47.55	46.31	45.91	44.58	38.58	39.25	37.66
400 meters	51.94	52.10	45.65	44.41	44.01	42.68	36.68	37.35	35.76
500 meters	50.54	50.70	44.25	43.01	42.61	41.28	35.28	35.95	---
750 meters	47.94	48.10	41.65	40.41	40.01	38.68	---	---	---
1.000 meters	46.04	46.20	39.75	38.51	38.11	36.78	---	---	---
1,250 meters	44.54	44.70	38.25	37.01	36.61	35.28	---	---	---
1,500 meters	43.34	43.50	37.05	35.81	35.41	---	---	---	---
1,750 meters	42.44	42.60	36.15	---	---	---	---	---	---
2,000 meters	41.54	41.70	35.25	---	---	---	---	---	---
2,250 meters	40.74	40.90	---	---	---	---	---	---	---
2,500 meters	40.04	40.20	---	---	---	---	---	---	---

Table IV-A11

Sound Level Values as They Vary With Distance
From Area Highways Using 24 Hour Average dB(A) Values
With No Attenuation Effects From Vegetation Cover

Distance	Int 55/70	Int 270	Hwy 157	Hwy 111	Hwy 203	Hwy 3	Hwy 162	Hwy 35	Hwy 772
15 meters	74.57	74.73	68.28	67.04	66.64	65.31	59.31	59.98	58.39
25 meters	72.35	72.51	66.08	64.84	64.44	63.11	57.11	57.78	56.19
100 meters	66.37	66.53	60.08	58.84	58.44	57.11	51.11	51.78	50.19
200 meters	63.37	63.53	57.08	55.84	55.44	54.11	48.11	49.98	47.19
300 meters	61.57	51.73	55.28	54.04	53.64	52.31	---	---	---
400 meters	60.27	60.43	53.98	52.74	52.34	51.01	---	---	---
500 meters	59.37	59.53	53.08	51.84	51.44	50.11	---	---	---
750 meters	57.57	57.73	51.78	50.04	49.64	48.31	---	---	---
1,000 meters	56.37	56.53	50.58	48.84	---	---	---	---	---
1,250 meters	55.37	55.53	49.58	---	---	---	---	---	---
1,500 meters	54.57	54.73	---	---	---	---	---	---	---
1,750 meters	53.87	54.03	---	---	---	---	---	---	---
2,000 meters	53.27	53.43	---	---	---	---	---	---	---
2,250 meters	52.77	52.93	---	---	---	---	---	---	---
2,500 meters	52.37	52.53	---	---	---	---	---	---	---

Table IV-A12

Sound Level Intensity Readings for Test Area #1

A. Description

1. #1 testing site is fifteen meters south of Highway 162 next to Cahokia Creek.

2. #2 testing site is 281 meters south of Highway 162 on the Norfolk and Western Railroad tracks by Cahokia Creek.

B. Sound Level Readings Using a General Radio Type 1564A Sound Analyzer

	Pass-By Event Readings
#1 site	63.6
	64.4
	64.1
#2 site	45.9
	44.1
	45.3

C. Prevailing Atmospheric Conditions, Time and Vegetation

1. March 21, 1600 to 1625 hours

2. Temperature = 58^{o} F; Relative Humidicy = 81%; Wind = light and variable

3. March type vegetation from forty meters to approximately one kilometer

Table IV-A13

Sound Level Intensity Readings for Test Area #2

A. Description

1. Test site #1 is located fifteen meters east of Highway 111 and is 744 meters south of the intersection of Highways 111 and 162.

2. Test site #2 is 806 meters south of the intersection of Highway 162 with Long Lake.

3. Test site #3 is 1.55 kilometers east of Highway 111 and 868 meters north of the northwest tip of Edelhardt Lake.

B. Sound Level Readings Using a General Radio Type 1564A Sound Analyzer

	Pass-By Event Readings
#1 site	66.1 67.6
#2 site	49.7 50.1
#3 site	38.6 40.4

C. Prevailing Atmospheric Conditions, Time and Vegetation

1. March 21, 1630 to 1720 hours

2. Temperature = 57^{o} F; Relative Humidity = 81%; Wind = northwesterly at three to five miles per hour

3. Open field short grass cover for test sites #1 and #2 from major highways; dense tree cover for test site #3 between Highway 162 and 111.

Table IV-A14

Sound Level Intensity Readings for Test Area #3

A. Description

1. #1 test site is located twenty-five meters north of Interstate 55/70 and 1.3 kilometers west of the Illinois Department of Transportation weighing station on Interstate 55.

2. The #2 test site is located on the levee 558 meters south-southeast of County Highway 35 and two kilometers north-northwest of the weighing station on Interstate 55/70.

3. The #3 test site is located one kilometer north-northwest of the weighing station on Interstate 55/70 and on the eastern edge of the internal ponding area associated with Cahokia Creek.

B. Sound Level Readings Using a General Radio Type 1564A Sound Analyzer

	Pass-By Event Readings
#1 site	68.9
	72.1
#2 site	45.9
	47.4
#3 site	44.2
	44.6

C. Prevailing Atmospheric Conditions, Time and Vegetation

1. March 20, 1700 to 1800 hours

2. Temperature = 49^{o} F; Relative Humidity = 88%; Wind = east-southeast at eight to ten miles per hour

3. Tall grass at test site #1, tall grass or dense tree cover at sites #2 and #3

Table IV-A15

Sound Level Intensity Readings for Test Area #4

A. Description

1. One test site along the east side of Highway 3, fifty meters from the highway and 1.96 kilometers south of Interstate 270.

B. Sound Level Readings Using a General Radio Type 1564A Sound Analyzer

	Pass-By Event Readings
#1 site	64.6
	62.9
	65.0

C. Prevailing Atmospheric Conditions, Time and Vegetation

1. March 20, 1530 to 1545 hours

2. Temperature = 49° F; Relative Humidity = 89%; Wind = east-southeast at eight to eleven miles per hour

3. Vegetative cover is medium to tall grass

Table IV-A16

Sound Level Intensity Readings for Test Area #5

A. Description

1. Test site #1 is thirty meters south of Interstate 270 along Cahokia Creek.

2. Test site #2 is 430 meters south of Interstate 270 along Cahokia Creek.

B. Sound Level Readings Using a General Radio Type 1564A Sound Analyzer

	Pass-By Event Readings
#1 site	71.3
	71.9
	70.5
#2 site	52.6
	53.0
	51.7

C. Prevailing Atmospheric Conditions, Time and Vegetation

1. March 20, 1400 to 1430 hours

2. Temperature = 49^{o} F; Relative Humidity = 91%; Wind = east-southeast at eight to ten miles per hour

3. Tall grass at site #1, tall grass or fallow land surface to the west, tall grass to the north and dense tree cover to the east at site #2